EMERGENCY
ACTION
GUIDES

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Table of Contents

SECTION I

SECTION II

EMERGENCY ACTION GUIDES

September 2006

Guides Revised: *

Table of Contents

September 2006

Guides Revised: *

Table of Contents

September 2006

Guides Revised: *

Table of Contents

ACKNOWLEDGEMENTS

The safety of our nations emergency responders is of primary concern to the American Association of Railroads. The Emergency Action Guides (EAGs) in this book have been prepared to assist emergency responders in safely responding to railroad emergencies in the initial phase of the incident. The EAGs were prepared using recognized reference sources and are based largely on the actual field experience of the railroad industry and hazardous materials product and container specialists from the emergency response community. All of the EAGs have received third party peer review. The Bureau of Explosives welcomes comments and suggestions for improvement of the EAGs. Comments should be directed to:

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DISCLAIMER

The material in this book was prepared by the American Association of Railroads for use as Emergency Action Guides (EAG) for first responders who arrive at an emergency prior to product and container specialists. The actions recommended in this book were designed to address immediate emergency situations and do not address all of the potential hazards and risks that may be encountered in developing a comprehensive strategy or tactics for mitigating a hazardous materials incident. Consequently, these data do not address all the potential hazards, particularly those hazards which arise when several chemicals become mixed. These guides, furthermore, do not deal with all of the considerations necessary for site safety plans, personal hygiene, sanitation, or decontamination of persons, clothing, tools, or machines.

There is no possible way that this book can cover the full spectrum of problems and contingencies for dealing with every type of hazardous material or dangerous goods incident. The information in this book should not be viewed by the user as a substitute for the good judgment of qualified hazardous materials specialists at the scene of the emergency. The users of this book are directed to seek the expert assistance of specially qualified persons. An excellent source for technical assistance is the Chemical Transportation Emergency Center (CHEMTREC) at (800) 424-9300. In Alaska, Hawaii and Canada call (703) 527-3887. CHEMTREC communicators can place individuals at the emergency scene in touch with the transporter and shipper of the products.

Emergency response work is extremely dangerous and many responders have died or sustained serious injury and illness while attempting to mitigate an incident. The users of this book are warned to exercise all necessary cautions when dealing with hazardous materials. Always place personal safety first.

Even though this book is based on commonly used emergency response practices, references, laws, regulations, and consensus standards, it is not meant to set a standard of operations for any emergency response organization. The user's are directed to develop their own Standard Operating Procedures which follow all system, agency, or employer guidelines for handling hazardous materials. It is the user's sole responsibility to stay up to date with procedures, regulations, and product developments which may improve personal health and safety.

SPECIAL NOTES FOR THIS EDITION

As warranted, usually when enough chemicals are identified as moving annually by tank car in sufficient quantity, the Bureau of Explosives issues a supplement to the Emergency Action Guides. The supplement usually consists of approximately 15 to 18 new commodities along with updates to existing EAGs. This publication is constructed alphabetically. Any new commodities should simply be inserted where they logically appear in relation to the other commodities. Unless instructed otherwise any updated EAGs are to replace existing ones.

The former pagination system, which combines alpha/numeric sequencing, is being phased out. Therefore any numbering scheme appearing at the top of existing pages is to be ignored. Front and back matter pages are to be replaced only when clearly identified as updates to existing material. With every supplement you can expect the following pages to be updated and in need of replacement: Title Page, Table of Contents, Status of Pages, and some or all of the Appendices F—I.

The Bureau of Explosives is in the process of updating the standard terminology in the older Emergency Action Guides to be consistent with definitions found in the 2004 Emergency Response Guidebook; NFPA 471, *Recommended Practice for Responding to Hazardous Materials Incidents*; NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*; and NFPA 473, *Standard for Competencies for EMS Personnel Responding to Hazardous Materials Incidents*. Until these older EAGs are updated users should be aware of the following.

Recently, there has been a recognition that in some instances *Shelter-In-Place* (Directing people to go inside of a building and remain indoors until the danger from a hazardous materials release has passed. Occupants must close doors and windows and shut down heating ventilation and air condition systems. See Appendix D for the complete definition.) can be used in place of an *Evacuation* (The controlled removal of people from an area of known danger or unacceptable risk to a safer area, or one where the risk is considered to be acceptable.) EAGs issued prior to the 2000 Supplement relied entirely on *Evacuation*. Until these earlier EAGs are revised to reflect this acceptance of *Shelter-In-Place*, users should refer Appendix D for the definition of *Shelter-in-Place* for instances when it can be used in place of *Evacuation*.

In the earlier EAGs the following terms have sometimes been used interchangeably. Users should use these definitions as guidance when using the action/consequence/mitigation approaches to chemical emergency response in an earlier EAG.

> Confinement - Those procedures taken to keep a material, once released, in a defined or local area (e.g., diking or damming).
>
> Containment - The actions taken to keep a material in its container (e.g., stop a release of the material or reduce the amount being released).
>
> Control - The defensive or offensive procedures, techniques, and methods used in the mitigation of a hazardous materials incident, including containment, extinguishment, and confinement.
>
> Damming - A water-based confinement tactic, (e.g., building an underflow dam to capture a petroleum product having a specific gravity less than 1).
>
> Diking - A land-based confinement tactic, e.g. building earthen dikes.
>
> Mitigation - Actions taken to prevent or reduce product loss, human injury or death, environmental damage, and property damage due to the release or potential release of hazardous materials.

In the 2006 Supplement, eighteen chemicals were updated. In these updated chemical a new TECHNIQUE “IMPLEMENT PUBLIC PROTECTION ACTIONS” was introduced as follows:

> Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

EAGs issued prior to 2006 that utilize evacuation or shelter-in-place should implement the above IMPLEMENT PUBLIC PROTECTION ACTION.

INTRODUCTION

The purpose of the hazardous materials Emergency Action Guides (EAGs) in this book is to provide accurate information about the hazardous commodities most frequently carried in bulk by rail transport. The guides were developed by the Association of American Railroads as part of a continuing effort to assist those who respond to transportation accidents involving hazardous materials and must assess the hazards at these incidents. The EAGs provide concise and accurate information for 268 commodities, representing about 98 percent by volume, of the hazardous materials most commonly carried in bulk by rail.

In addition to helping emergency responders identify chemicals and assess their hazards, the EAGs provide information to aid in the protection of the public and the environment. Using response techniques without fully considering the hazards and risks or the consequences is a common problem at many hazardous materials incidents. While taking prompt action may initially appear to control and suppress the problem, other problems more serious and worse than the first may arise as a result of the initial action taken which was not well though out. For example, flooding a spilled chemical with water may quickly remove the chemical from the immediate spill area and appear to improve the situation but may actually create a much more serious problem by contaminating sewer systems, water treatment facilities, lakes, rivers, and ground water. A more effective control method may be to simply contain the spilled chemical by a dike made of dirt until experts arrive on scene.

The unique feature of these guides is in their presentation of the action/consequence/mitigation approach to chemical emergency response. Potentially adverse consequences associated with each response technique and with ways to counteract such consequences, are described. The suggested response techniques do not, however, preclude other actions, which may be appropriate. The intent of these guides is to promote the development of alternative response techniques suitable for use at a spill incident. The hope of those who developed this book is that knowledge and use of the action/consequence/mitigation approach may prevent a situation from becoming worse than it already is.

The information in the EAGs is not a substitute for the knowledge gained by product and container specialists from actual field experience. This experience is especially critical in the assessment of damage to railroad tank cars and other containers. The EAGs will be most useful during actual incidents if they have first been used as part of first responder training. In training sessions, the guides can be supplemented by the experience of hazardous materials specialists.

Organization

This book is organized into three sections followed by a series of nine appendices. Section I contains a brief overview of the chemical emergency preplanning process. Section II discusses the overall design of the Hazardous Materials Emergency Action Guides and their user aids. Section III contains the guides themselves. The appendices give information about sources of additional aid chemical recognition, identification, and classification and a glossary of the technical terms used in the guides.

SECTION I

CHEMICAL EMERGENCY PLANNING

Preplanning is essential for hazardous materials emergency response. Preplanning requires knowing what kinds of accidents can happen, what must be done to control the situation and mitigate the damage and, perhaps most of all, knowing what resources will be needed and who can supply them. Unlike other emergency situations such as auto accidents or structure fires, a chemical release will require special talents uncommon to typical fire and police duties.

A good response plan must coordinate community services with outside responders; it is neither sufficient nor smart simply to assume that local governmental services are all that are available. If the emergency involves hazardous materials, help from the chemical producing and transporting industries and from state and federal agencies is only a phone call away. Knowing who to call and bringing them in during the earliest stages of preplanning for these emergencies will produce a plan that will work.

Individual railroads have developed contingency plans for handling derailments, floods, and other operating emergencies. Each company is also prepared to address chemical releases. Many railroads offer training or informative programs to communities along their lines. Railroad representatives can provide a great deal of information concerning railroad procedures, information sources, and communication networks vital to an emergency.

Like the railroads, and many other major transportation companies, the people who produce hazardous materials have also developed the capability to respond to accidents.

Federal and state emergency personnel, including the Environmental Protection Agency (EPA), the Coast Guard (USCG), the Federal Emergency Management Agency (FEMA), the Department of Energy (for radioactive materials), state offices of emergency preparedness, state police departments, fire marshals, and state environmental and public health offices can provide emergency response information and assistance.

Preplanning and coordination will both minimize confusion and greatly expand the resources available to a community. Because it is important to know who these people are and, better yet, to involve them in the earliest planning stages, a list of industry and governmental agencies available for information and assistance is found in Appendix E in this book. A place has been provided in Appendix E for the names and telephone numbers of other contacts developed in the preplanning process.

ACCIDENT ASSESSMENT

Safety is the first priority in responding to any accident. Thinking safety is even more important when the accident involves—or might involve—hazardous materials. It is absolutely necessary to know the properties of the materials involved. Some hazardous materials cannot be seen or smelled and yet there may be chemicals leaking in gas, liquid, or solid form. The danger of sudden fires or explosions must be assumed.

It is entirely possible that the scene of an accident involving hazardous materials will represent such a high degree of hazard that the only safe course is to protect the perimeter and evacuate those who may become exposed to the dangers of toxic fumes or violent container ruptures. These severe hazards may exist with or without the presence of fire, smoke, or odors.

If an accident involving hazardous materials happens, IMMEDIATELY:

1. Notify local emergency response authorities. The transportation carrier should also be notified.
2. Make an initial survey of the scene, determining the:

   - Location of threatened or potentially threatened people,
   - Presence of fire, smoke or fumes,
   - Presence of hazardous materials,
   - Overall condition of the vehicles and containers, wind direction and approximate speed; and
   - Type of terrain, including the proximity of streams or lakes.

3. Rescue the injured, if possible. Emergency response personnel must be adequately protected against the dangers present before any rescue is attempted. The EAGs list suggested protective clothing and respiratory equipment. Once rescue personnel are properly equipped, look for injured drivers and passengers in truck cabs and railroad personnel in each locomotive or near the train as well as for civilian casualties. If injuries appear to be due to chemical exposure, identify which chemicals are involved. In general, remove victims to fresh air and remove all chemical-soaked clothing. First aid personnel should protect themselves against direct contact with contaminated clothing or material.

4. Identify the specific products, cars, trailers or containers involved. The train crew or truck driver will have shipping papers containing this information. In a rail yard or truck terminal, the shipping papers are usually in the yard office or dispatcher's office. Placards applied to vehicles and/or labels on packages may help identify the presence or absence of hazardous materials, but the shipping papers are the best source of on-scene identification information. Appendices A, B, and C are provided to help interpret placards and markings. If the shipping papers and/or placards or labels are destroyed, the number on the rail car or motor vehicle can often be used to secure the name of the commodity being carried. Rail car numbers (also called reporting marks) are a series of letters followed by a series of numbers as in the following example: ABCX 12345. Many trucks use a similar numbering pattern. With this number, the carrier, or CHEMTREC at 800-424-9300 (in Alaska, Hawaii and Canada call (703) 527-3887).

   Using the guides in this book, identify and learn the dangerous characteristics of the hazardous materials involved and the generally applicable emergency response information. If an accident involves a commodity not in this book, *Emergency Handling of Hazardous Materials in Surface Transportation,* also published by the AAR's Bureau of Explosives, contains information on each DOT regulated hazardous material. If the only available commodity information is the 4-digit number on a vehicle placard or a 49 HAZMAT Code (7-digits) on a shipping or movement document, the cross reference appendices at the back of this book will help locate emergency response information. Placards on vehicles and labels on packages may also contain a single number at the bottom. This is a hazard class number assigned by the International Maritime Organization (IMO). A list of IMO class numbers and their divisions appear in Appendix C. Use this information to help identify commodities when planning evacuations, mitigation activities, personnel safety, and ultimate clean up.

5. Do not release any product(s) from containers or attempt to ignite or detonate either the products or the containers without expert advice and assistance.

6. If it is necessary to drag rail cars or other transport vehicles as a part of accident clearing operations, it should only be done with the expert advice and assistance of persons trained in and familiar with such techniques.

7. Sheltering-In-Place is the preferred and most effective method of protecting people who may be exposed to a short term airborne release of toxic hazardous materials. Emergencies of long duration involving airborne releases of toxic hazardous materials or flammable or explosive materials may require an evacuation. The size of the evacuation area, if any, will depend on the type and quantities of materials involved as well as weather and topographical conditions. Vapor clouds should be monitored for downwind hazards. The evacuation area may be modified as conditions change and additional information is obtained. Evacuation, while not always necessary, must be considered when a hazardous materials emergency occurs. The decision whether or not to evacuate must be made after considering the potential hazards and risks of the incident and the impact the evacuation may have on public safety. Evacuation may add to the immediate problems. Preplanning must include evacuation procedures which are coordinated with emergency management agencies and law enforcement authorities.

8. The shipper(s) should be contacted for additional information on the product(s) involved. Additional emergency response information is available from:

   CHEMTREC 800-424-9300
   In Alaska, Hawaii and Canada call (703) 527-3887.
   Puerto Rico and the Virgin Islands can use the "800" number.
   (In many cases, the CHEMTREC communicator will be able to establish direct contact with the shipper(s) of the product(s) involved.)

If you have the following information when you call, help will be able to reach you much faster:

1. Your name, location, and telephone number
2. Location of the incident
3. Carrier involved
4. Vehicle reporting marks (Car or truck numbers)
5. Placard/label applied
6. Name of commodity and shipper
7. Accessibility
8. Weather conditions
9. Local population information
10. Topographical features
11. Availability of water

Accident Mitigation

When fires are involved, the specific chemicals involved must be identified because conventional firefighting techniques are not always appropriate. The fact that a substance is on fire does not necessarily indicate that the fire should be put out or suppressed with water or any other material. For instance, water is not generally effective against hydrocarbon liquids, gases, or cryogenic liquids. Large amounts of water combined with spilled chemicals may do more to spread a hazard than to eliminate it. In some cases, foams added to water may be more appropriate. Where flammable liquids or gases are leaking and on fire, it may be better to let them burn unless the leak(s) can be stopped.

Escaping vapors or liquids may present a much greater hazard than fire. Identify sensitive areas in the path of released chemicals. Sewer systems and streams should be protected from chemical runoff. It is important to keep the hazard from spreading, because it is difficult and expensive to restore damaged areas. The EAGs provide commodity specific information on mitigation techniques.

Container Damage Assessment

Severe exterior damage to rail cars that appears serious may not have even effected the container's integrity. In contrast, a dent or gouge that looks small may lead to sudden total failure, especially if the tank is pressurized.

The full assessment of the accidental damage suffered by a container of hazardous materials—especially bulk containers such as tank cars, tank trailers, intermodal portable tanks and large cylinders ("ton containers")—is a matter for experts. If there is any question about the continuing integrity of a tank, experts should make an examination before decisions about moving the tank or transferring its contents are made. Expertise is available from container manufacturers, some transportation companies, the Hazardous Materials Services (BOE) (the AAR's Bureau of Explosives' services can be obtained through CHEMTREC), and some shippers of dangerous products.

Evaluating damaged rail cars is a very specialized area of expertise and it is difficult to list general guidelines for emergency responders. Some initial considerations are set out below for evaluating the damage to bulk containers that are NOT involved in a fire. (For fire considerations, see the following discussion of thermal ruptures [BLEVE]).

- Damage to only the outer skin or jacket of a tank will not usually reduce the strength of the tank itself, but training is necessary to recognize the difference between jacketed tanks and those that have no outer skin.

- As a very general rule of thumb, large dents are worse than small ones; dents—even if they are small—with sharp creases are worse than dents with "gentle" edges; dents with sharp bottoms are more dangerous than those with rounded bottoms; and one of the most dangerous situations of all exists when the metal of a tank is so damaged that it has folded back on itself.

- As another very general criteria, the scratches that a tank gets from sliding over dirt, gravel, or similar surfaces are not usually "fatal;" but gouges, especially those that have removed metal from the surface of the tank itself, and even more especially if the gouges continue to remove metal through the tank welds, can be VERY dangerous.

THERMAL RUPTURES (BLEVE)

The common definition of BLEVE refers to the thermal rupture of a tank. Briefly explained, when a railroad tank car is exposed to fire below the level of the liquid contained in it, the contents of the car act to transmit the external heat into the load with a consequent boiling (or vaporization) of some of the product. In the presence of liquid/metal contact, heat is conducted away from the tank and into the liquid and the heat is dispersed; where only product vapors contact the internal wall of the tank, the heat cannot be conducted away from the container wall adequately.

If and when the pressure inside a tank car builds up to the pressure relief valve setting, the valve opens, releasing product vapor. This pressure release results in a cooling of the contents of the car. Continued heating will cause this process to cycle as long as the heat input remains below the liquid level. As each opening of the safety valve releases product, it reduces the surface area in contact with the internal tank shell..

When the liquid level drops low enough that fire impinges on the tank surface with only vapor behind it, the vapor cannot remove the heat efficiently from the tank shell and the metal heats up. As the tank shell heats, the metal begins to lose tensile strength. If the heat is allowed to impinge on the tank shell without some way of dissipating it (an externally applied water stream has been effective in some, but not all cases), the metal will be reduced in strength to the level of the internal pressure. At that point, a tear will open in the tank shell and, if the tear runs in a ductile manner (i.e., "plastic," or with metal thinning), the tank will come apart violently. Often the car rips into three pieces: the head nearest the tear, that part of the tank in which the tear started (and which usually opens up to a large flat piece of steel), and the remainder of the car, which may "rocket" away from its original location.

EVACUATION RECOMMENDATIONS

Overview

At a hazardous materials incident, there are generally two reasons for an evacuation. One is to protect the public from any toxic, poisonous, or noxious vapors or fumes generated by the product itself; the second is to protect the public from thermal ruptures [(BLEVE)] and the container debris that may be hurled from an incident site. Container ruptures may, with some hazardous materials, also result in sudden massive fires or even fireballs. Responders should realize that both reasons for evacuation may exist at a single accident and that not all container ruptures are caused by fire or heat.

Evacuation may be necessary for public safety, but the process has dangers of its own. Studies show that those evacuated suffer stress. The evacuated area will have to be protected from vandalism. Evacuees may forget to turn off stoves and electrical appliances and these may start dwelling fires. Law enforcement or emergency management agencies resources may be limited and the evacuation may need to be conducted in stages, with people at greatest risk evacuated first.

While the evacuation distances and considerations contained in these Guides are the best judgment of technically trained and qualified people, they should only be used to *guide* the evacuation. Any evacuation distance may be modified based on the observations of trained responders at the incident who have made an assessment of the hazards. Those "in charge" at an incident must recognize that trained, professional industrial responders are aware of the risks involved in responding to a hazardous material release and they should be allowed to enter the scene to perform their work. It should also be realized that, as environmental or spill conditions change, any evacuation distance should be reconsidered and modified.

Protection From Vapors or Fumes

Protecting the public from toxic, poisonous, or noxious vapors or fumes requires consideration of site-specific information. Evacuation recommendations require knowledge about the nature of the chemical involved; the rate of its release; air temperature, wind speed, and other atmospheric conditions; and the terrain and vegetation surrounding the release. Because these are unique to each incident, the user of these Guides is advised to seek the aid of persons knowledgeable about the product and the effect of significant variables on it. Local and state air pollution officials are a source for this assistance, as are hazardous materials experts from chemical producing and transporting companies.

Instead of recommending specific evacuation perimeter distances to protect from these fumes and vapors, these Guides use phrases like "Down wind evacuation must be considered," and "Consider evacuation of the immediate spill area."

Protection From Thermal Ruptures

Thermal ruptures and their effects have been extensively studied, especially where they involve pressurized bulk containers. Actual distances traveled by container fragments have been measured and, where specific distances are given for fire-related ruptures, they are based on this history, rounded upwards for safety and convenience. The different distances given as recommendations are also based on factors such as the violent rupture potential of the product, any secondary or tertiary hazards it may have (whether or not they meet the DOT or IMO hazard class definitions) and the kind and size of container authorized for its transportation.

If a rupture occurs, the usual pattern is for the container to break in several pieces, but the rupture may or may not be violent depending on the incident conditions and the chemicals involved. If there is a violent rupture, it is likely that approximately the first 500 to 600 feet from the bulk container of liquefied petroleum gas will experience a fireball and radiant heat. The next 500 to 600 feet (out to a radius of approximately 1200 feet) will experience radiant heat from the fireball. Container fragments, sometimes massive in size, have traveled further than 1200 feet and can set fires beyond this perimeter. Where specific distances are recommended for ruptures caused by fire, those distances are based on a conservative estimate of the possible distance container debris might be hurled.

PERSONAL PROTECTIVE CLOTHING

Protective clothing is a key element in safe emergency response to a chemical release. In order to choose the correct clothing and equipment to perform a task, an initial assessment of the potential risks to human exposure must be made. Do not take unnecessary risks: injury to key responders just adds to the problem and delays the effective solution.

While a detailed treatment of personal protective clothing is beyond the scope of these Guides, the following should be considered:

- Hazards of the released chemicals
- Routes of possible chemical exposure
- Concentration of released chemicals
- Availability of equipment and trained personnel
- Possible chemical reactions at the scene
- Length of possible exposure
- Type of work to be performed
- Potential for additional chemical releases
- Environmental factors, (such as wind, rain, temperature)

When approaching an unknown or undefined hazardous materials release, full chemical protective clothing should be worn to protect the responder from adverse exposure until the actual conditions can be determined. Once the site situation is determined, an adequate level of protective clothing can be established.

Levels of Protection

Protective clothing is designed to eliminate (or at a minimum, reduce) chemical exposure to responders. The U.S. Environmental Protection Agency (USEPA) has recommended four levels of protective clothing when approaching a spill and/or hazardous waste site. These are outlined below. Fire fighters should realize that typical turnout gear *is not* full chemical resistant protective clothing, rather, this type of clothing provides closer to level B or C protection.

Level A **Maximum protection: high respiratory and high skin protection needed**

Level A Conditions:
- unknown gaseous concentrations
- known gaseous contaminants in high concentrations
- known gaseous contaminants that are extremely toxic
- possible or expected skin exposure to toxic or poisonous substances

Level A Personal Protective Equipment:
- positive pressure, self-contained breathing apparatus (OSHA/NIOSH approved)
- fully-encapsulating chemical resistant suit
- gloves (inner) chemical resistant, steel toe and shank (depending on suit boot construction, worn over or under suit boot)
- gloves (outer) chemical resistant
- underwear, cotton, long john type*
- hard hat (under suit)*
- disposable protective suit, gloves, and boots (worn over fully-encapsulating suit)*
- coveralls (under suit)*
- 2-way radio communications (intrinsically safe)

* optional equipment

Comment: This level of clothing would be worn for protection from exposures to dioxin, cyanide compounds, and concentrated pesticides.

Level B **Moderate protection:** High respiratory protection needed; skin protection needed but not of highest concern

Level B Conditions:
- known contaminant levels, and these contamination levels exceed the limit of air purifying devices
- atmosphere with less than 19.5% (by volume) of oxygen
- atmosphere with chemical concentrations above the Immediately Dangerous to Life and Health (IDLH) level.

Level B Personal Protective Equipment:
- positive pressure, self-contained breathing apparatus (OSHA/NIOSH approved)
- chemical resistant clothing (overalls and long sleeved jacket; coveralls; hooded, two-piece chemical-splash suit; disposable chemical resistant coveralls)
- coveralls (under splash suit)*
- gloves, outer, chemical resistant
- gloves, inner, chemical resistant boots, outer, chemical
- resistant, steel toe and shank
- boots, outer chemical resistant (disposable)*
- 2-way radio communications (intrinsically safe)
- hard hat*
- face shield*

* optional equipment

Comment: This level of clothing would be worn when responding to highly concentrated chemical atmospheres like fuming nitric acid or oleum.

Level C **Medium protection:** Limited respiratory protection needed; skin protection needed but not of high concern

Level C Conditions:
- atmosphere with greater that 19.5% (by volume) of oxygen
- atmosphere with chemical contaminant levels below ILDH limits
- chemical contaminants have adequate warning properties
- chemical contamination to unprotected areas such as head and neck are within skin exposure guidelines
- skin contact hazards are minimal or do not exist

Level C Personal Protective Equipment:
- full-face, air-purifying respirator (OSHA/NIOSH approved)
- chemical resistant clothing (one-piece coverall; hooded, two piece chemical splash suit; chemical resistant hood and apron; disposable chemical resistant coveralls)
- gloves, outer, chemical resistant
- gloves, inner, chemical resistant*
- boots, steel toe and shank, chemical resistant
- cloth coveralls (inside chemical protective clothing)*
- hard hat (face shield)*
- boots, outer, chemical resistant (disposable)*
- 2-way radio communications (intrinsically safe)

- escape mask

* optional equipment

Comment: The difference between level B and level C is in respiratory protection: at level C a full face chemical air purifying respirator is allowed to substitute for a pressure demand, self contained breathing apparatus. However, the chemical resistant clothes requirements are the same.

Level D Minimum protection: no respiratory protection required

Level D conditions:
- no possibility for respiratory exposure
- no possibility for skin contamination

Level D Personal Protective Equipment:
- Coveralls
- boots/shoes, safety or chemical resistant steel toe and shank
- boots, outer (chemical resistant disposables) *
- safety glasses or chemical splash goggles *
- hard hat (face shield) *
- escape Mask *
- gloves *

* optional equipment

Comment: This level of clothing is basic work clothes.

Chemical Compatibility

There is *no single ideal material* that offers protection from all chemicals. In fact, materials highly recommended for some chemicals may be totally unsuitable for others. Manufacturers of protective clothing do not provide blanket assurances that a generic type of material will be suitable for every chemical. For these reasons, these Guides use language such as "compatible materials may include . . . ." The Association of American Railroads recommends that persons and organizations purchasing protective clothing discuss the intended usage of it with the manufacturer or sales organization. Always determine the suitability of protective clothing *before* entering the immediate spill area.

Respiratory Protection

There are two basic types of respiratory protection: air supplied and air purifying. Air supplied respirators include positive pressure self-contained breathing apparatus (SCBA) or supplied air-line devices. Both of these should have full facepieces and should operate at positive pressure, that is, with a slight pressure in the facepiece at all times to prevent inward leaks of airborne contaminants.

Air Purifying Respirators (APR) are designed to filter airborne contaminants in atmospheres where there is an adequate concentration of oxygen (above 19.5%). These respirators may either have a full-face piece or a half-face piece (covering the nose and mouth) and a cartridge containing the filtering material. Care must be exercised to ensure that the type of cartridge used is appropriate for the specific contaminants at the incident. It is essential that the responder be aware that these devices should never be used in atmospheres where the oxygen concentration is less than 19.5% by volume. (Normal breathing atmospheres contain 20.9% oxygen by volume.) Responders without training in wearing respiratory protection and in performing self tests for proper facepiece fit should receive instruction before entering the area where the device is needed.

Maintenance of Protective Clothing

In order to maintain the integrity of protective clothing it should be regularly inspected and regularly maintained. Contact with a competent safety officer, industrial hygienist, or the equipment manufacturer will aid in establishing such a program. A word of caution: Responders should inspect all equipment, before donning. Any defective part should be fixed or replaced. Don't wear cracked or damaged clothing. This pre-donning inspection should include checks for:

- Cracks, brittleness, pinholes, or tears in the fabric;
- Zipper failure
- Cracks on the facepiece, rubber surface and seal;
- Condition of valves, canisters, warning devices, and hoses.

THINK SAFETY.

GENERAL SPILL SITE SAFETY PRECAUTIONS

These guides cannot deal with all of the considerations necessary to protect the health and safety of those responding to a chemical incident, but certain generally recognized precautions should be taken as a matter of course. These include recommendations to:

- Wash hands before eating, smoking, or using toilet facilities.
- Prohibit eating and smoking where any chemical is spilled.
- Prohibit rewearing of potentially contaminated clothing.
- Store potentially contaminated clothing in closed containers until the chemical is removed or the clothing is properly discarded.
- Provide facilities for flushing the eyes or skin with water (and soap or detergent) as necessary.
- Establish decontamination stations through which all personnel, tools and machines must pass before leaving a site contaminated with spilled chemicals.

The NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards contain additional ideas for precautionary measures that may need to be considered. In addition, experts in safety, industrial hygiene and related fields may play a vital role in mitigating the potential for danger at an emergency involving chemicals.

Responders should also be aware of the need to maintain excellent physical fitness as a defense against the extra stress of handling an emergency. Regardless of body condition, factors such as the heat stress from wearing chemical protective clothing and the nervous stress of being in a life threatening environment will cause fatigue. Often the responder will tire much more quickly than normal and with fewer of the usual warning signs. Individual alertness and an awareness of other responder's reactions can prevent a dangerous situation from turning fatal.

SECTION II

EMERGENCY ACTION GUIDES FORMAT

Each Emergency Action Guide (EAG) is intended to supply those who respond to a chemical accident with enough information to handle a spill until expert support can be obtained. First response activities recommended in the guides are intended to minimize both short-term and long-term hazards to health and the environment.

All guides are organized into a consistent format. The cover page identifies and describes the commodity; gives physical/chemical data; and hazard identification information. The second and third pages, and in rare instances the fourth page, are devoted to potential hazards, protective clothing and equipment, first aid and general response information. At the top of the second and third pages are colored illustrations of placards, USDOT emergency numbers, and NFPA Fire Diamonds. The fourth, fifth, and sixth pages are devoted to response activities and environmental effects using the action/consequence/mitigation approach. Following the EAGs are a number of appendices including a Department of Transportation placard chart; the National Fire Protection Association 704 diamond system explanation chart; the International Maritime Organization hazard class definitions; a glossary of technical terms; emergency telephone numbers for industry and governmental agencies; a chemical name cross reference; a UN number cross reference; and a 49 HAZMAT code cross reference.

An explanation of the major sections of the guide follows:

Cover

1. *Chemical name*
2. *Description* of the commodity.
3. The *Chemical/Physical Data* section lists the physical and chemical properties of the material. These proper- ties include solubility in water and other chemicals, specific gravity, heat of combustion, flash point, auto- ignition temperature, reactivity with water and other chemicals and other data available for the particular commodity.
4. The *Identification* section lists shipping names, synonyms, and other trade names of the material along with its chemical formula, constituent compounds, the Standard Transportation Commodity Code number (STCC), the International Maritime Organization Code (IMDG), and United Nations (UN) designations. Physical properties of the commodity such as the physical state as shipped (liquid, gas, solid) and as released as well as color, odor, and common uses of the material are also given.
5. *Telephone numbers* for CHEMTREC.

Inside Left Page

6. The *Heading* displays a picture of the DOT placard, the name of the commodity, and the U. S. Department of Transportation (DOT) Hazard Class.
7. *Potential hazards* are subdivided into the following categories: *General hazards,* identifying short term exposure limits, general conditions to avoid, and unusual hazards of the material; *Health hazards,* describing how the material affects the body through contact, inhalation, or ingestion; *Fire hazards,* listing flammable limits, behavior in fire, toxic combustion products; and *Explosion hazards,* describing conditions contributing to explosion, general risks of explosion, and upper and lower explosion concentration limits.
8. The *Protective Clothing and Equipment* section lists the suggested protective clothing and breathing apparatus based on information from a number of recognized sources.

Inside Right Page

9. The *Heading* repeats the name and hazard class of the commodity. The orange panel is used in conjunction with the placard on the right hand side of the inside left page as an alternate display. On the right hand side is a fire diamond from the National Fire Prevention Association (NFPA) Hazard Signal System (Standard 704).
10. The *First Aid* section gives non-specific symptoms and first aid for inhalation, contact, and ingestion. Exposure levels are from NIOSH unless other data is available in the absence of any NIOSH data.
11. The *Fire Response* section lists compatible extinguishing materials and recommended techniques.
12. *Spill Responses.* At the beginning of this block is a general comment regarding the effects of the material on the surrounding environment and basic safety considerations. This is followed by techniques that will minimize the environmental impact of the spill, whether it has entered air, land, or water. Comments on the secondary consequences resulting from the use of these techniques and suggested methods to mitigate the effects of those consequences are included under each category.

Recognizing that every chemical spill is unique, these EAGs are designed to assist the user in evaluating alternative response actions and in selecting those actions most appropriate to the circumstances of a particular spill. By becoming familiar with the various response techniques and with the Action/Consequence/Mitigation process, one can consider the suitability of additional response methods.

Appendices

The appendices explain, define, illustrate, or list the following items:

A. Department of Transportation (DOT) placards.
B. National Fire Prevention Association (NFPA) fire diamonds.
C. International Maritime Organization (IMO) Dangerous Goods Code (IM-DG) numbers.
D. Glossary of terms
E. Industry and government agencies for information and assistance.
F. Chemical name cross reference.
G. United Nations (UN) code number cross reference.
H. 49 HAZMAT code cross reference.

Data in these guides were collected from a variety of sources that are considered reliable and accurate.

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January 1988

ACETALDEHYDE
Class 3 (Flammable liquid)

GENERAL INFORMATION

Acetaldehyde is a highly volatile colorless liquid with a penetrating and pungent fruity odor. It is used for making various other chemicals, synthetic rubber, perfumes, dyes, mirrors, plastics, pesticides, and pharmaceuticals and has uses in several other products and processes. It is fully soluble in water. Its flash point of –36°F indicates that the product can be easily ignited under all ambient temperature conditions. Its boiling point of about 69°F and its considerable vapor pressure indicate that the product will boil in warm weather and will otherwise evaporate rapidly to produce large amounts of heavier than air vapors. These vapors may travel a considerable distance to a source of ignition and flash back and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.5 pounds per gallon.

Acetaldehyde does not react with water or many common materials, but prolonged exposure to air may result in the formation of peroxides that may explode and burst the container. The product is non-corrosive to most metals, but oxidizes readily to form acetic acid. Exposure to heat, dust, strong oxidizing or reducing agents, or strong acids or bases may result in potentially violent self-polymerization. The product is an irritant and of moderate toxicity. It may be present in air in high concentrations. Products of combustion are irritating and may include toxic constituents.

Downwind evacuation should be considered if acetaldehyde is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

***Solubility in Water**:* Soluble in all proportions.
Solubility in Other Chemicals: Soluble in alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.780 at 68°F (20°C)
Boiling Point: 68.7°F (20.4°C) at 1 atm..
Melting Point: –185.8°F (–121°C)
Freezing Point: –189°F (–123°C)
Molecular Weight: 44.05
Heat of Combustion: –5890 cal/g
Vapor Pressure: 750 mm Hg (14.5 psia) at 68°F (20°C)
Flash Point: –36°F (37.8°C), closed cup; –58°F (–150°C), open cup.
Autoignition Temperature: 347–365°F (175–185°C)
Burning Rate: 3.3 mm/minute
Stability: Stable
Corrosiveness: Attacks some forms of plastics, rubber, and coatings. Noncorrosive to most metals but oxidizes readily to acetic acid.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with acids, acid anhydrides, bases, alkalis, alcohols, anhydrous ammonia, bromine, chlorine, fluorine, hydrogen sulfide, iodine, ketones, phenols, strong oxidizing or reducing agents, amines, and hydrogen cyanide.

IDENTIFICATION

Shipping Names: Acetaldehyde (USDOT and IMO); ethyl aldehyde (USDOT and IMO).
Synonyms and Tradenames: Acetic aldehyde; ethyl aldehyde; ethanal.
Chemical Formula: CH_3CHO
Constituent Components(% each): Over 99% pure with rest mostly water.
49 STCC: 49 072 10
UN/NA Designation: UN1089
IMO Designation: 3.1, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Gas or liquid; boils at 68.7°F
Color of the Shipped Material: Colorless
Odor Characteristics: Penetrating, pungent, sharp, and fruity
Common Uses: Mfg. of synthetic rubber, perfumes, flavors, dyes, explosives, disinfectants, mirrors, plastics, pesticides, and pharmaceuticals; hardening of gelatin, glues, and casein products; leather and food preservative.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ACETALDEHYDE

Class 3 (Flammable liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.01-0.031ppm.

Unusual Hazards: Highly volatile, flammable, and moderately toxic substance with heavier than air vapors. May boil or rapidly evaporate to produce large quantities of vapor. May self-polymerize violently under appropriate conditions (see General Information section). Vapors may persist in pits, hollows, and depressions.

Short Term Exposure Limits(STEL): 150ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 100ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations in air that may result from spills. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid acetaldehyde may result in irritation, redness, possibly burns, and possibly an allergic skin rash. Contact with the eyes may cause a burning sensation, secretion of tears, blurred vision, and possibly severe burns.

Hazards of Inhalation: Vapors of acetaldehyde may cause irritation of the eyes, nose, and throat. High concentrations in air may cause narcosis with symptoms including drowsiness, dizziness, headache, nausea, vomiting, unconsciousness, and possibly death. Delayed pulmonary edema may follow from severe exposures. A concentration of 200 ppm in air causes eye irritation in 15 minutes in humans. A level of 13600 ppm was lethal to cats in 15 minutes in laboratory experiments.

Hazards of Ingestion: Ingestion may result in drowsiness, dizziness, unconsciousness, kidney damage, and severe breathing difficulties that may be delayed in onset.

FIRE HAZARDS

Lower Flammable Limit: 4%

Upper Flammable Limit: 57-60%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently. Will generate large quantities of flammable gas or vapor upon release.

Hazardous Combustion Products: Not well-defined but considered irritating. May include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Violent polymerization may occur in presence of certain chemicals (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

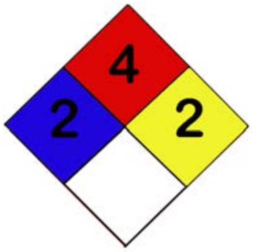
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor concentrations in air. Compatible materials may include butyl rubber, polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10000 ppm), a selfcontained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with front or back mounted organic vapor canister (10000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use of limitations of these devices.

1089

ACETALDEHYDE

Class 3 (Flammable liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, or skin; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water fog or spray. Water may be ineffective but may be used in large amounts to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Unusual toxic vapor hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Before responding, take into account that acetaldehyde is an extremely volatile and flammable substance with heavier than air vapors. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment, that acetaldehyde may polymerize violently under conditions described in the General Information section, and that accumulations of heavy vapors may persist for a time in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Acetaldehyde spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ACETALDEHYDE

Class 3 (Flammable liquid)

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to acetaldehyde vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of acetaldehyde from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid acetaldehyde may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of acetaldehyde vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Acetaldehyde may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained acetaldehyde may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ACETALDEHYDE

Class 3 (Flammable liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ACETALDEHYDE

Class 3 (Flammable liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2006

ACETIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Acetic acid is a colorless liquid with a sour, pungent odor resembling vinegar. The glacial acid is relatively pure and becomes a solid at about 62°F, but the product may also be shipped as a solution in water, as it is fully soluble in water. It is used as a food additive and for making rubber, nylon and fiber, dyes, vitamins, antibiotics, hormones, and a variety of other products and chemicals. A flash point of 104°F indicates that high ambient temperatures or some degree of heating is necessary before glacial acetic acid can be ignited easily. Accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. Containers of liquid have some potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. Glacial acetic acid weighs approximately 8.8 pounds per gallon.

Acetic acid does not react with water and is stable in normal transportation. It is corrosive to most common metals, particularly when diluted with water, and will attack many forms of plastics or rubber. It is also reactive with a variety of chemicals. Concentrated acid may burn bodily tissues by all routes of exposure, and the vapors are severely irritating. Products of combustion may also be irritating. Properties of acetic acid given in the following guide are for the glacial product unless indicated otherwise.

If acetic acid is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions for liquids and at least 75 feet (25 meters) for solid. For larger spills, increase in the downwind direction as conditions warrant. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, diethyl ether, glycerol, carbon tetrachloride and ether.

Specific Gravity (Liquid): 1.051 at 68°F (20°C)

Vapor Density: 2.1 (glacial); 3.45 (solution)

Boiling Point: 244.2°F (117.9°C) at 1 atm.

Melting Point: 61.9°F (16.6°C)

Freezing Point: 62.1°F (16.7°C)

Molecular Weight: 60.05

Heat of Combustion: –3136 cal/g

Evaporation Rate: 0.97

Vapor Pressure: 11 – 11.4 mmHg (0.213 – 0.220 psia) at 68°F (20°C)

Flash Point: 104°F (40°C), cc; 112°F (44.4°C), open cup

Autoignition Temperature: 800 – 869°F (426.7 – 465°C)

Burning Rate: 1.6 mm/minute

Flammable (Explosive) Limits: 4.0% (LEL) – 16% (UEL)

Stability: Stable

Polymerization Potential: Will not occur

pH: 2.4 (1.0M solution)

Corrosiveness: Attacks most common metals including most stainless steels, particularly when diluted. Dissolves synthetic resins or rubber. Use aluminum, 316SS, or 318SS for containers.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with chromic acid, sodium peroxide, nitric acid, acetaldehyde, ammonium nitrate, 2-amino-ethanol, chlorosulfonic acid, ethylene glycol, perchloric acid, ethylene diamine, ethylene imine, hydrogen peroxide, oleum, permanganates, xylene, sodium or potassium hydroxide, phosphorus trichloride, strong oxidizers or caustics, and various other chemicals.

IDENTIFICATION

Shipping Names: Acetic acid, glacial (USDOT & IMO); Acetic acid solution (USDOT & IMO).

Synonyms and Tradenames: Ethanoic acid; Methane carboxylic acid; Vinegar acid; Ethylic acid; Glacial acetic acid; Acetic acid (aqueous)

CAS Registry No.: 64-19-7

Chemical Formula: CH_3COOH

Constituent Components (% each): Glacial is about 99.5%

UN/NA Designation: UN2789 (glacial, > 80% solution); UN2790 (≤80% solution)

IMO Designation: UN2789 (8, corrosive substances; 3, flammable liquids); UN2790 (8, corrosive substances)

RTECS Number: AF1225000

NFPA 704 Hazard Rating: 3 (Health): 2 (Flammability): 0 (Instability) (glacial)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sharp; pungent; sour odor like vinegar.

Reportable Quantity: See appendix I

Common Uses: Food additive; petroleum production; mfg. of rubber, nylon, fiber, dyes, aspirin, plastics, solvents, pharmaceuticals, and other chemicals and products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ACETIC ACID

Class 8 (Corrosive Material)

*UN2789 (glacial, > 80% solution);
UN2790 (≤80% solution)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.2–24 ppm reported, neither odor nor degree of irritation are adequate indicators of vapor concentration.

Unusual Hazards: Corrosive combustible organic acid that solidifies at moderate temperatures when relatively pure. Heavier than air vapors that may travel to a source of ignition and flash back. Vapors may persist for a time in pits, hollows and depressions.

Short Term Exposure Limits (STEL): 15 ppm (37 mg/m^3) (NIOSH)

Time Weighted Average (TLV-TWA): 10 ppm (25 mg/m^3) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 50 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazards are from inhalation of concentrated vapors in the spill vicinity and direct physical contact with concentrated liquid acid. Ingestion of concentrated acid is also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with concentrated (50% or more) acetic acid may cause moderate to severe skin burns. More dilute solutions may cause relatively mild injury. Contact of concentrated acid with the eyes may result in severe injury with possibly permanent corneal opacification; while 4–10% (in vinegar) causes pain and conjunctival hyperemia, sometimes with injury to the corneal epithelium.

Hazards of Inhalation: Vapors of acetic acid may irritate the eyes, nose, throat, and lungs and may damage these tissues severely if concentrated. Symptoms may include coughing, chest pain, nausea, vomiting, and delayed breathing difficulties involving pulmonary edema and bronchopneumonia.

Hazards of Ingestion: Ingestion of concentrated glacial acetic acid may result in perforation of the esophagus (reported as little as 1.0 ml), bloody vomit, diarrhea, shock, hemolysis, hemoglobinuria, anuria and possibly death.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 4.0%

Upper Flammable (Explosive) Limit: 16%

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite when cool. There is some potential that containers may rupture violently in fire.

Hazardous Combustion Products: Carbon monoxide, carbon dioxide and other toxic and irritating products. May include unburned acid.

EXPLOSION HAZARDS

Explosive Potential: There is some potential that containers may rupture violently in fire. Explosion may result if vapors from warm liquid are ignited in a confined area. Contact with metals may produce explosive hydrogen gas.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

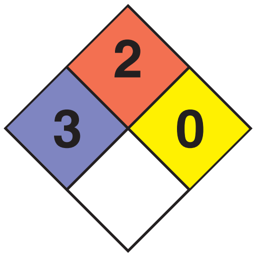
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with concentrated acetic acid. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, polyethylene, chlorinated polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, Viton®, and nitrile-butadiene rubber. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 2; Tychem® SL; Tychem® CPF 4; Tychem® Responder®; Tychem® Responder® CSM; Tychem® TK; Tychem® F; Tychem® Reflector®; Tychem® ThermoPro; Teflon® (gloves, suits, boots); 4H® and Silver Shield® brand gloves; Neop. Chloroflex 723 gloves; Chem Master gloves; N5/N8 Chloroflex gloves; Butyl 878 gloves; Viton® 890 gloves; Neoprene 6780 gloves; Ultraflex Neoprene 32 gloves; Nitty Gritty 65NFW gloves; Ultraflex Nitrile 22R gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Viton® (gloves, suits); Tychem® BR; Tychem® LV; Hustler PVC 725R gloves; Nitri Solve 727 gloves. The following materials are ***not*** recommended for use: Tychem® QC and Tychem® CPF 3.

2789

2790

ACETIC ACID

Class 8 (Corrosive Material)



Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 50 ppm): any supplied-air respirator operated in a continuous-flow mode (eye protection needed); any powered air-purifying respirator with organic vapor cartridge(s) (eye protection needed); any air-purifying full-facepiece respirator equipped with organic vapor cartridge(s); any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece.

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, nose, throat or skin; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid using mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact do not delay, remove contaminated clothing immediately and wash skin with plenty of cold water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Alcohol-resistant foam, dry chemical, carbon dioxide or water spray. Water may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Possible corrosive vapor or fume hazard.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the corrosiveness and reactivity of product with many common metals when deciding on the appropriate response and equipment. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust. Consult a qualified specialist on neutralization techniques. Take into account while planning the response that acetic acid may be highly corrosive and reactive. Contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Vapors may be heavier than air vapors and may persist for a time in low areas. Relatively pure acetic acid solidifies at moderate ambient temperatures.

ACETIC ACID

Class 8 (Corrosive Material)

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Acetic acid, may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill by checking for pH until the spilled product is removed.

CONSEQUENCE

Hazardous levels of acetic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acetic acid vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water spray should be applied to vapors present downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain acetic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL-RESISTANT FOAM . . . There is a possibility that alcohol-resistant foam applied to the surface of liquid pools may slow the release of acetic acid vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid acetic acid may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ACETIC ACID

Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Acetic acid may be contained by building dikes using soil, dry sand or other materials.

CONSEQUENCE

Contained acetic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

ACETIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

January 1988

ACETIC ANHYDRIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Acetic anhydride is a colorless liquid with a strong, pungent, and sour odor resembling vinegar. It is used in making fibers, plastics, lacquers and coatings, films and tapes, cigarette filters, pharmaceuticals, perfumes, explosives, weed killers, and a variety of other chemicals and products. It dissolves and reacts slowly with water to form acetic acid with the evolution of heat (which may be considerable if water spray is applied to the product). Its flash point of 120–127°F indicates that some degree of preheating is necessary before acetic anhydride can be ignited easily. Nevertheless, there is some potential that accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. The product weighs approximately 9 pounds per gallon.

Acetic anhydride is stable in normal transportation. It is corrosive to iron, steel, and other metals, and may eventually cause burns in contact with bodily tissues. It will also attack some forms of plastics, rubber and coatings, and is reactive with a variety of other chemicals. Products of combustion may be toxic and irritating.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.
Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 1.084 at 68°F (20°C)
Boiling Point: 282–284°F (138.9–140°C) at 1 atm.
Melting Point: –99.6°F (–73.1°C)
Freezing Point: –101°F (– 73.9°C)
Molecular Weight: 102.09
Heat of Combustion: –3921 cal/g
Vapor Pressure: 4 mm Hg (0.077 psia) at 68°F (20°C)
Flash Point: 120–127°F (48.9 – 52.8°C), closed cup; 132–136°F (55.6–57.8°C), open cup.
Autoignition Temperature: min. 600°F (315.6°C); max. 734–750°F (390–398.9°C); reported values vary.
Burning Rate: 3.3 mm/minute *Stability:* Stable
Corrosiveness: Corrodes iron, steel and other metals. Use aluminum or stainless steel. Will attack some forms of plastics, rubber, and coatings.
Reactivity with Water: Reacts slowly to evolve heat and acetic acid.
Reactivity with Other Chemicals: Reacts with chromic acid, sodium hydroxide or peroxide, glycerol, nitric acid, mineral acids, permanganates, alcohols, potassium hydroxide, strong oxidizers, strong caustics, amines, 2-aminoethanol, aniline, boric acid, ethylene imine, hydrogen fluoride or chloride, and several other chemicals.

IDENTIFICATION

Shipping Names: Acetic anhydride (USDOT and IMO)
Synonyms and Tradenames: Acetic acid, anhydride; acetic oxide; acetyl anhydride; acetyl ether; acetyl oxide; ethanoic anhydride; hydroxy biacetyl.
Chemical Formula: $(CH_3CO)_2O$
Constituent Components (% each): 75–100% pure
49 STCC: 49 313 04
UNINNA Designation: UN1715
IMO Designation: 8, corrosive
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Strong, pungent, sour, like vinegar.
Common Uses: Mfg. of fibers, plastics, lacquers, coatings, films and tapes, cigarette filters, pharmaceuticals, perfumes, explosives, weed killers, and other products and chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ACETIC ANHYDRIDE

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.14–0.36 ppm
Unusual Hazards: Relatively corrosive combustible liquid that reacts with water.
Short Term Exposure Limits (STEL): Unavailable
Time Weighted Average (TLV-TWA): 5 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Acetic anhydride poses a corrosive hazard to bodily tissue by all routes of exposure.
Hazards of Skin or Eye Contact: Although a burning sensation is not felt immediately, liquid acetic anhydride may cause reddening of the skin followed by skin becoming white and wrinkled and eventually burned. Contact with the eyes causes immediate burning followed by increasing injury and possibility of permanent loss of sight. Concentrated vapors are also harmful to the skin and eyes.
Hazards of Inhalation: Vapors of acetic anhydride may cause irritation of the eyes, nose; and throat as well as coughing. High concentrations may cause ulceration of nasal membranes, bronchospasm, difficult breathing, and possibly severe damage to the lungs with delayed effects.
Hazards of Ingestion: Ingestion may produce serious burns of the mouth and esophagus, burning pain in the stomach, nausea, and vomiting.

FIRE HAZARDS

Lower Flammable Limit: 2.7–2.75%
Upper Flammable Limit: 10–12.4%
Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite when cool.
Hazardous Combustion Products: Not well-defined but considered toxic and irritating.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors from warm liquid are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (250 ppm or less) or an organic vapor cartridge respirator with a full facepiece (250 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific symptoms: Irritation or burns of any tissue; coughing and other symptoms of inhalation or ingestion.
***First Aid for Inhalation*:** Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least *15* minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.
First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

1715

ACETIC ANHYDRIDE
Class 8 (Corrosive Material)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, dry chemical, carbon dioxide, and large amounts of water spray. Water may be used to dilute spills to nonflammable mixture but control any runoff. Note that dry chemical forced below the surface may cause foaming and boiling.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool. Note that water reacts with acetic anhydride to evolve acetic acid and heat.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Acetic anhydride may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of acetic anhydride in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb acetic anhydride vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain acetic anhydride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize -as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of acetic anhydride vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

ACETIC ANHYDRIDE

Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE .

CONTAINMENT DIKES . . . Acetic anhydride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained acetic anhydride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . . Spreading of acetic anhydride may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Although sorbents will immobilize the spill and help control spreading, they do not alter the hazardous nature of the spilled product. Their use adds to the volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

ACETIC ANHYDRIDE
Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders arid scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

ACETONE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Acetone is a volatile colorless liquid with a sharp sweet odor resembling that of nail polish remover or paint. It is used as a solvent in paints and nail polish removers and for making pharmaceuticals, adhesives and other chemicals. It is fully soluble in water. Its flash point of 0°F indicates that the product may be easily ignited under most ambient temperature conditions. Vapors are somewhat heavier than air when concentrated and may travel to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. The product weighs approximately 6.6 pounds per gallon.

Acetone does not react with water or many other common materials and is stable in normal transportation. It attacks several forms of plastics and rubber, and is reactive with a variety of other chemicals. The product is generally of low to moderate toxicity by the various potential routes of exposure but may be present in air in high concentrations. Products of combustion include carbon dioxide and carbon monoxide.

If acetone is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 0.791 at 59°F (15°C)
Vapor Density: 2.0
Boiling Point: 133.2°F (56.2°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –138°F (–94.7°C)
Molecular Weight: 58.08
Heat of Combustion: –6808 cal/g
Evaporation Rate (butyl acetate=1): 5.6 – 7.7
Vapor Pressure: 180 mmHg (3.48 psia) at 68°F (20°C); 400 mmHg at 104°F (39.5°C)
Flash Point: 0°F (–17.8°C), cc; 4°F (–15.6°C), oc
Autoignition Temperature: 869°F (465°C)
Burning Rate: 3.9 mm/minute
Flammable (Explosive) Limits: 2.5% (LEL) – 12.8% (UEL)
Stability: Stable
Polymerization Potential: Will not occur
pH: Not available
Corrosiveness: Attacks many forms of plastics and rubber including rayon.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizing agents, chromyl chloride, chromic anhydride, chromyl alcohol, hexachloromelamine, hydrogen peroxide, potassium tertbutoxide, thioglycol, aliphatic amines, nitric and acetic acid, nitric and sulfuric acid, nitrosyl chloride, nitrosyl perchlorate and permonosulfonic acid. Reacts with chloroform and bromoform under basic conditions.

IDENTIFICATION

Shipping Names: Acetone (USDOT & IMO)
Synonyms and Tradenames: 2-Propanone; Dimethyl ketone; beta-Ketopropane; Methyl ketone; Pyroacetic ether, Dimethyl-ketal; Dimethyl formaldehyde; Propanone; Ketone propane
CAS Registry No.: 67-64-1
Chemical Formula: CH_3COCH_3
Constituent Components (% each): 99.5% pure remaining mostly water.
UN/NA Designation: UN1090
IMO Designation: 3, flammable liquids
RTECS Number: AL3150000
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Instability)
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sharp, sweet, pungent; like fruit, mint, or nail polish remover.
Reportable Quantity: See Appendix I
Common Uses: Solvent for paints, nail polish removers, and other products; mfg. of drugs, adhesives, pesticides, lube oils, and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ACETONE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reports vary 0.66–320 ppm, most fall within 13–62 ppm

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back or persist in low areas.

Short Term Exposure Limit (STEL): 750 ppm (ACGIH 2004)

Time Weighted Average (TLV-TWA): 250 ppm (590 mg/m^3) (NIOSH); 1000 ppm (2400 mg/m^3) (OSHA); 500 ppm (ACGIH 2004)

Ceiling (C) Limit: Unavailable

IDLH: 2500 ppm (10% LEL)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of very high vapor concentrations in air. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid acetone may cause drying and cracking of the skin due to the defatting action of the product. Contact with the eyes may result in eye irritation, conjunctivitis, and usually some degree of temporary corneal injury.

Hazards of Inhalation: High concentrations of acetone vapors may lead to central nervous system depression, symptoms may include headache, drowsiness, incoordination, dizziness, confusion, nausea, and unconsciousness. High concentrations in air may be irritating to the eyes, nose, throat and lungs.

Hazards of Ingestion: Ingestion may result in irritation of the mucous membranes, gastritis, nausea, vomiting and central nervous effects. May be an aspiration hazard and may be fatal.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 2.5%

Upper Flammable (Explosive) Limit: 12.8%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable vapor upon release.

Hazardous Decomposition Products: May include carbon dioxide and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

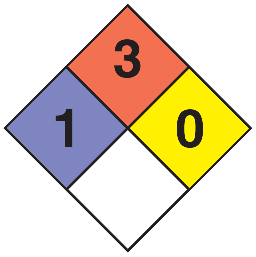
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include latex rubber or butyl rubber. The following materials are reported to have a greater than 8 hour breakthrough time: butyl rubber (gloves, suits, boots); Tychem® (CPF 3; CPF 4; BR; LV; Responder®; Responder® CSM; TK; F; Reflector®; ThermoPro); Barricade® coated suits; CPF3® suits; Trellchem HPS® suits; Butyl 878® gloves; Viton® 892; 4H® and Silver Shield® brand gloves. The following materials are **not** recommended for use: nitrile latex; Tychem® (CPF 2; SL; CPE; CPF 1; QC; PVC).

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2500 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 2500 ppm): any air-purifying half-mask respirator* equipped with organic vapor cartridge(s); any powered air-purifying respirator* with organic vapor cartridge(s); any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; any supplied-air respirator*; or any self-contained breathing apparatus with a full facepiece. Note: Respirators noted with (*) may require eye protection.

1090

ACETONE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, or throat; central nervous system depression and other symptoms of inhalation, physical contact, or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 15 minutes. Get medical attention immediately if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Alcohol-resistant foam, dry chemical, carbon dioxide or water fog or spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish fire unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Acetone will completely dissolve in water. Dike fire control water for proper disposal since it may contain flammable vapors. Note that acetone has a flash point of 0°F.

SPILL RESPONSES

General Information: Acetone is a highly flammable and volatile liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of acetone may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment are isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that acetone is a highly flammable substance that may evaporate rapidly, dissolve in water and is lighter than water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

ACETONE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Acetone may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed.

CONSEQUENCE

Hazardous levels of acetone in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acetone vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain acetone from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL-RESISTANT FOAM . . . There is a possibility that alcohol-resistant foam applied to the surface of liquid pools may slow the release of acetone vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid acetone may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ACETONE

Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Acetone may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained acetone may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible, non-combustible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ACETONE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

ACETONE CYANOHYDRIN, STABILIZED

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Acetone cyanohydrin is a colorless to straw color or brownish liquid with a cyanide or bitter almond odor, but may be odorless at low temperatures. It is highly toxic by inhalation or ingestion. It is used to make plastics, insecticides, pharmaceuticals, foaming agents and other chemicals. It is completely soluble in water and forms a colorless to straw color solution. Having a flash point of 165ºF, acetone cyanohydrin must be moderately heated before ignition may occur easily. There is some potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration since heat causes dissociation to acetone and hydrogen cyanide, both highly flammable materials. The latter substance is also a highly toxic gas. Acetone cyanohydrin weighs approximately 7.8 pounds per gallon.

Acetone cyanohydrin does not react with water and other common materials but is reactive with a variety of chemicals. Reactions with organic acids, isocyanates, epoxides, or nitrides may be explosive. Carbon steel, type 316 stainless steel, Teflon®, compressed asbestos, and buna S rubber are not attacked under most conditions. Although the product is generally stable in transportation, some decomposition to acetone and toxic hydrogen cyanide gas can be expected even in ambient storage. The products of combustion, according to one manufacturer, may be less hazardous than decomposition products (i.e., acetone and hydrogen cyanide).

Downwind evacuation should be considered if acetone cyanohydrin is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in alcohol, acetone, ether, and benzene. Slightly soluble in petroleum ether.

Specific Gravity (Liquid): 0.932 at 66ºF (19ºC)

Vapor Density: 2.93

Boiling Point: One source reports 176ºF (82ºC) while another lists 330ºF (166ºC) at 1 atm for decomposing.

Melting Point: -5.8ºF (-21ºC)

Freezing Point: See melting point

Molecular Weight: 85.11

Heat of Combustion: Unavailable

Evaporation Rate (butyl acetate=1): <1

Vapor Pressure: 0.8 mmHg (0.015 psia) at 68ºF (20ºC)

Flash Point: 165ºF (74ºC), closed cup

Autoignition Temperature: 1270ºF (688ºC)

Burning Rate: Unavailable

Flammable Limits: 2.2% (LEL) - 12.0% (UEL)

Stability: Generally stable but some decomposition to acetone and hydrogen cyanide can be expected.

Polymerization Potential: Will not occur.

pH: Unavailable

Corrosiveness: Unavailable

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with mineral acids, alkalis and alkaline earth metals, strong reducing agents, organic acids, isocyanates, epoxides, nitrides, azo and diazo compounds, hydrazines, and caustics.

IDENTIFICATION

Shipping Name(s): Acetone Cyanohydrin, stabilized (USDOT & IMO)

Synonyms and Tradenames: Lactonitrile, 2-methyl; ACY; ACN; alpha-Hydroxyisobutyronitrile; 2-Hydroxy-2-methylpropionitrile; 2-Hydroxy-2-methylpropanenitrile; Isopropylcyanohydrin.

CAS Registry No.: 75-86-5

Chemical Formula: $(CH_3)_2C(OH)CN$

Constituent Components (% each): 97-99% pure (or more) with traces of HCN, water, acetone, stabilizer, and inerts.

UN/NA Designation: UN1541

IMO Designation: 6.1, Toxic substances

RTECS Number: OD9275000

NFPA 704 Hazard Rating: 4(Health): 2(Flammability): 2(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless to straw colored or brown.

Odor Characteristics: Like cyanide (bitter almond), but may be odorless at low temperatures.

Reportable Quantity: See appendix I.

Common Uses: Manufacturing of plastics, insecticides, pharmaceuticals, foaming agents, and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ACETONE CYANOHYDRIN, STABILIZED

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic by inhalation or ingestion. Decomposes at 248ºF and at lower temperatures under alkaline conditions with evolution of highly toxic hydrogen cyanide. Some decomposition expected even in ambient storage. The substance is very toxic to aquatic organisms.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: 1 ppm (4 mg/m^3)

IDLH: Unavailable

Conditions to Avoid: Contact with ignition sources, heat, alkalies, or other incompatible materials; runoff to water or sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Acetone cyanohydrin is highly toxic by inhalation or ingestion and possibly by skin absorption. A major hazard is the potential for the product to evolve highly toxic hydrogen cyanide gas (see general information section).

Hazards of Skin or Eye Contact: Liquid acetone cyanohydrin may be absorbed through the skin and cause toxic effects. Contact may cause smarting of the skin and first degree burns upon short exposure. Prolonged exposures may result in secondary burns.

Hazards of Inhalation: Breathing vapors may result in dizziness, headache, nausea, mental dullness, rapid and/or irregular heartbeat, weak pulse, convulsions, and possibly unconsciousness and death. High concentrations in air may also irritate the eyes and respiratory system. Acetone cyanohydrin is highly toxic.

Hazards of Ingestion: Ingestion may result in the symptoms identified above for excessive inhalation.

FIRE HAZARDS

Lower Flammable Limit: 2.2%

Upper Flammable Limit: 12%

Behavior in Fire: Combustible liquid. Containers may rupture violently in fire. Heat will cause decomposition to acetone and highly toxic hydrogen cyanide.

Hazardous Decomposition Products: Toxic fumes of carbon monoxide, carbon dioxide, nitrogen oxides, hydrogen cyanide and acetone.

EXPLOSION HAZARDS

Explosive Potential: Reactive at high temperature or pressure. Containers may rupture violently in fire. Contact with other chemicals such as nitrides, organic acids, isocyanates, epoxides, alkali or alkaline earth metals, and certain other substances may result in violent polymerization or the formation of explosive mixtures. Explosion may result if vapors of heated liquid are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

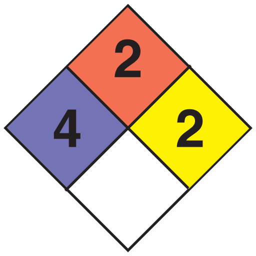
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Tychem® 9400, Tychem® BR and Tychem® 10000 are reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or where increased possibility of exposure exists, a self-contained breathing apparatus (SCBA) with full facepiece.

1541

ACETONE CYANOHYDRIN, STABILIZED

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Irritation or burns due to direct contact. Other symptoms of inhalation, ingestion, or absorption via skin.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious, administer artificial respiration. Administer amyl nitrite by crushing pearl in a cloth and lightly holding under nose 5 times for 15 seconds at about 15 second intervals. Repeat every 5 minutes as necessary for 3-4 pearls. Administer oxygen if victim remains unconscious or breathing is difficult. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer amyl nitrite as described above. Give one pint of 1% sodium thiosulfate solution (or soapy or mustard water) by mouth and induce vomiting. Repeat until vomit is clear. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Alcohol resistant foam, carbon dioxide, dry chemical, or water spray. Do not use soda-acid extinguisher.

Extinguishing Techniques: Unusual toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to rupture potential. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Take into consideration the highly toxic nature of acetone cyanohydrin while planning the response. Downwind evacuation should bo considered. Proceed with caution. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Restrict access to area. Keep unprotected personnel upwind. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Choose equipment that is not corroded or otherwise damaged by the spilled product. Consider using a buddy system due to the hydrogen cyanide gas hazard.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

ACETONE CYANOHYDRIN, STABILIZED
Division 6.1 (Poisonous Materials)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acetone cyanohydrin vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of acetone cyanohydrin from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid acetone cyanohydrin may slow the release of vapors into the atmosphere. If possible, adjust pH to 7 to suppress formation of hydrogen cyanide.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

OIL APPLICATION . . . Application of a fuel oil to the surface of liquid pools may reduce emissions of vapors or fumes.

CONSEQUENCE

Addition of oil will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL RESISTANT FOAM . . . There is a possibility that alcohol resistant foam applied to the surface of liquid pools may slow the release of acetone cyanohydrin vapors into the atmosphere. (Note: The fact that alcohol resistant foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol resistant foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

ACETONE CYANOHYDRIN, STABILIZED

Division 6.1 (Poisonous Materials)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid acetone cyanohydrin may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Liquid acetone cyanohydrin may be confined by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Confined acetone cyanohydrin may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ACETONE CYANOHYDRIN, STABILIZED

Division 6.1 (Poisonous Materials)

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

August 1994

ACROLEIN*
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Acrolein is a clear colorless or yellowish liquid with an acrid, piercing, and disagreeable odor. It is moderately soluble in water and is likely to form a colorless to light yellow solution. Its low flash point indicates that it can easily be ignited under most ambient temperature conditions.

Acrolein's boiling point and relatively high vapor pressure indicate that it will rapidly vaporize under normal conditions. This may result in the evolution of relatively large amounts of vapor. These vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as sewers or buildings may result in explosion. Containers of liquid acrolein may explode if exposed to fire or excessive heat for sufficient time duration.

Acrolein does not react with water or many other common materials. It is stable in normal transportation and shipped with an inhibitor, however, exposure to high temperatures (above 392°F), light, alkalies, and strong acids may promote self-polymerization. This may result in the evolution of heat and possibly the violent or explosive rupture of the container. Acrolein is very toxic by all routes of exposure and all exposures should be avoided.

Downwind evacuation should be considered if the product is leaking but not on fire. If the product container is exposed to direct flame or the fire becomes uncontrollable, evacuate for a radius of 2500 feet for protection should the container rupture violently. Acrolein is used in making plastics, pharmaceuticals, herbicides, and other chemicals. It is also used as an herbicide and as a fungus inhibitor in fuel mixtures. Acrolein weighs approximately 7 pounds per gallon.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 21 - 22 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, and acetone.

Specific Gravity (liquid): 0.841 - 0.845 at 68°F (20°C)

Vapor Density (Air = 1): 1.94

Boiling Point: 126.5°F (52.5°C) at I atm.

Melting Point: - 125.9 to - 124.4°F (- 87.7 to - 86.9°C)

Freezing Point: - 125°F (- 87°C)

Molecular Weight: 56.07

Heat of Combustion: - 6950 cal/g.

Vapor Pressure: 215 mm Hg (4.16 psia) at 68°F (20°C)

Flash Point: - 15°F (- 26°C), CC

Autoignition Temperature: 453°F - 532°F (234°C - 278°C)

Burning Rate: 3.8 mm/minute.

Stability: Normally stable. May violently polymerize if exposed to heat, contamination or light.

Corrosiveness: Non-corrosive to iron and low carbon steel unless accompanied by extreme heat.

Reactivity with Water: No reaction, dissolves.

Reactivity with Other Chemicals: Reacts with air, alkaline materials, amines, thiourea, oxidants, heat and light, sulfur dioxide, metal salts, acids, 2-aminoethanol, ethylene diamine, and ethyleneimine.

IDENTIFICATION

Shipping Names: Acrolein, inhibited (USDOT); acrolein, inhibited (IMO)

Synonyms and Tradenames: Propenal; 2-propenal; acrylic aldehyde; acrylaldehyde; acraldehyde; allyl aldehyde; ethylene aldehyde; aqualin; NSC 8819; prop-2-en-l-al; 2-propen-l-one; slimicide; biocide; trans-acrolein; acquinite; crolean; magnicide H; CAS 107-02-8.

Chemical Formula: CH_2=CHCHO

Constituent Components (% each): 92% or more pure; water is major contaminant; also has less than 1% inhibitor such as hydroquinone.

UN/NA Designation: UN1092

IMO Designation: 6.1, poisonous material.

Physical State as Shipped: Liquid, inhibited.

Physical State as Released: Liquid, inhibited.

Color of the Shipped Material: Colorless or yellowish.

Odor Characteristics: Disagreeable, causes tears; acrid, pungent.

Common Uses: Intermediate for synthetic glycerol, polyurethane, and polyester resins and pharmaceuticals; herbicide; warning agent in gasses; liquid fuel antimicrobial agent; chemical synthesis; biocide, agent in military chemical weapons; perfumes; colloidal forms of metal; plastics.

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*Reportable Quantity (RQ) established. Refer to appendix I.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ACROLEIN
Division 6.1 (Poisonous Material)

Square background
applicable to rail cars

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.05 - 0.4 ppm (0.125 - 1 mg/m^3)

Unusual Hazards: Highly flammable, toxic, and volatile liquid. Vapors are heavier than air. Heat, light, or chemical contaminants may promote violent self-polymerization. Vapors are uninhibited and may form polymers in vents or flame arrestors resulting in stoppage.

Short Term Exposure Limits (STEL): 0.3 ppm (0.75 mg/m^3). (OSHA)

Time Weighted Average (TLV-TWA): 0.1 ppm (0.25 mg/m^3) over each 8 hours of a 40 hour work week. (OSHA)

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly toxic by all routes of exposure. Toxic vapors may travel considerable distances. Flammable liquid and under conditions of heat, exposure to light, and contamination, may polymerize violently.

Hazards of Skin and Eye Contact: Contact with liquid acrolein may cause severe skin or eye burns. Acrolein may also be absorbed via the skin in toxic amounts.

Hazards of Inhalation: Breathing of acrolein vapors may cause irritation, coughing, dizziness, headache, nausea, cyanosis, pulmonary edema, and possibly death. Exposure to 150 ppm in air may be lethal to humans in 10 minutes. Onset of pulmonary edema may be delayed.

Hazards of Ingestion: Ingestion may severely irritate the mouth and stomach and produce acute gastrointestinal distress and pulmonary edema. Onset of effects may be delayed..

FIRE HAZARDS

Lower Flammable Limit: 2.8%

Upper Flammable Limit: 31%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure to excessive heat may result in violent polymerization. May generate large quantities of flammable gas or vapor upon release.

Hazardous Combustion Products: Unburned acrolein, carbon monoxide, peroxides, and others.

EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Loss of inhibitor or excessive heat or light may cause spontaneous violent polymerization resulting in container rupture. Violent polymerization may also occur in presence of alkaline materials, amines, metal salts, thiorourea, oxidants, sulfur dioxide, and acids.

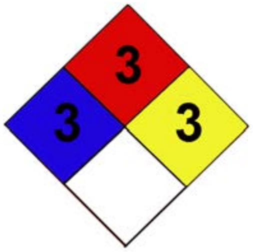
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or a chemical cartridge respirator with a full facepiece within the use limitations of these devices.

1092

ACROLEIN
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, skin, or respiratory tract, coughing, dizziness, headache, nausea, chest pains, and others.

First Aid For Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention iqmmediately. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of pulmonary edema. Onset may be delayed and symptoms may grow progressively worse with time.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if there is evidence of irritation or chemical burns.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting not be induced if immediate medical attention is available). Be alert to delayed and progressive signs of systemic toxicity.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with acrolein. Wear self contained breathing apparatus and appropriate personal protective clothing. Move intact container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. Avoid taking positions along container ends. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water may be used to dilute acrolein pools to non-flammable concentrations.

SPILL RESPONSES

General Information: Proceed with caution. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Eliminate ignition sources. Use explosion-proof equipment where necessary. Note that acrolein is a highly flammable, toxic, and volatile substance in planning a response. Choose equipment where possible that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Acrolein spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ACROLEIN
Division 6.1 (Poisonous Material)

AIR SPILL *(CONTINUED)*

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acrolein vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of acrolein from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of acrolein vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid acrolein may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid acrolein may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained acrolein may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ACROLEIN
Division 6.1 (Poisonous Material)

LAND SPILL *(CONTINUED)*

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substance.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gasses present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

ACROLEIN
Division 6.1 (Poisonous Material)

WATER SPILL *(CONTINUED)*

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

July 1994

ACRYLAMIDE*
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Pure acrylamide is a white, odorless crystalline powder, but is typically shipped as an aqueous solution. While the properties of the pure crystalline form are fairly well defined, the solution behavior will depend largely on the nature of the solvent carrier. Typically, acrylamide is found in a 50% aqueous (water) solution. Since acrylamide can polymerize, such solutions are usually treated with copper salts and stored in the presence of oxygen to inhibit polymerization. Other solvents can be used to carry acrylamide depending on the ultimate use of the product. Acrylamide is not particularly flammable and will likely polymerize when heated. Ignition in aqueous solutions is possible after the water has evaporated. Flammability in other solvent carriers will depend on the nature of the solvent. The principal source of danger is due to its toxicity. On direct contact, it is a strong irritant to skin, eyes and other mucous membranes and can be absorbed through intact skin. Consequently, adequate protective measures should be implemented.

Because acrylamide is soluble in water, it will disperse in water bodies and will readily dissolve in runoff from firefighting operations. Contaminated solutions will present a risk of exposure to personnel. Vapors from spills of acrylamide solids and aqueous solutions are not likely to pose a significant source for personnel exposures. If acrylamide is shipped in a solvent other than water, the solvent should be identified to determine the risk added by the solvent. Acrylamide has numerous commercial uses as treatments for paper products, adhesive preparations, and is found in water and sewage treatment products.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble (215.5 gm/100ml @ 30°C (86°F))

Solubility in Other Chemicals: Soluble in methanol, ethanol, and acetone. Slightly soluble in ethyl acetate, chloroform, and benzene.

Specific Gravity (solid): 1.122 gm/cc @ 30°C (86°F)

VaporDensity(Air=1): Unavailable.

Boiling Point: 125°C @ 25 mmHg (257°F)

Melting Point: 84.5°C (184.1°F)

Freezing Point: 84.5°C (184.1°F)

Molecular Weight: 71.08

Heat of Combustion: Unavailable.

VaporPressure: 6.75 mmHg @ 25°C (77°F) (solid)

Flash Point: Unavailable.

Autoignition Temperature: Unavailable.

Burning Rate: Unavailable.

Stability: Stable at normal environmental temperatures, however, may violently polymerize when heated to melting point (84.5°C, 184.1°F). Readily polymerizes on exposure to ultraviolet light. Stabilized with oxygen and copper salts or antioxidants such as hydroquinone; t-butylpyrocatechol; n-phenyl-2-napthylamine.

Corrosiveness: Non-corrosive but avoid contact with iron, copper, aluminum, brass, and bronze.

Reactivity with Water: Not water reactive, dissolves.

Reactivity with Other Chemicals: Reacts in the presence of Uv light to polymerize, possibly violently. Incompatible with oxidizers, acids, bases, iron, copper, aluminum, brass, and bronze.

IDENTIFICATION

Shipping Names: Acrylamide, acrylamide solution.

Synonyms and Tradenames: 2-propenamide; propenamide; acrylic amide; ethylenecarboxamide; vinyl amide; propenoic acid amide; CAS 76-06-1.

Chemical Formula: $CH_2CHCONH_2$

Constituent Components (% each): 100% acrylamide in solid form; 50% solution with water, inhibited.

UN/NA Designation: UN2074

IMO Designation: 6.1, poisonous material.

Physical State as Shipped: Solid, liquid inhibited.

Physical State as Released: Solid, liquid inhibited.

Color of the Shipped Material: Colorless.

Odor Characteristics: Odorless.

Common Uses: Synthesis of dyes, adhesives, soil conditioning agents, sizing for paper and textiles, waste treatment chemicals and permanent press fabrics.

*Reportable Quantity (RQ) established Refer to appendix I.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ACRYLAMIDE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: No threshold odor concentration is reported for acrylamide. In liquid form, odor may be characteristic of the solvent carrying acrylamide.

Unusual Hazards: Acrylamide is readily absorbed through the skin and will produce neurotoxic effects. Direct contact with acrylamide should be avoided.

Short Term Exposure Limits (STEL): None reported in the U.S.

Time Weighted Average (TLV-TWA): 0.03 mg/m^3 (0.0102 ppm) (Skin), OSHA final PEL,

Conditions to Avoid: Contact with water, or incompatible materials; runoff to sewers or water; inhalation of dusts, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major public health risk is from direct contact with acrylamide or acrylamide solutions. Exposures are likely through contaminated foods, contaminated water, or direct contact with spilled material. Inhalation is unlikely unless acrylamide dusts become airborne. Direct exposures can produce irritation and neurotoxic effects. Highly toxic. May cause central nervous system paralysis.

Hazards of Skin and Eye Contact: Acrylamide is readily absorbed through intact skin which is the major route of exposure. Exposure will produce local irritation, and if the dose is sufficient, neurotoxic symptoms will develop. These include tremor, dizziness, numbness, loss of coordination and vision changes. Symptoms may be delayed depending on the severity of exposure.

Hazards of Inhalation: Acrylamide will likely cause irritation of the mucous membranes in the respiratory tract on inhalation of acrylamide dusts. It is readily absorbed through the respiratory tract and will produce neurotoxic effects. While a possible route of exposure, inhalation is unlikely unless conditions permit acrylamide to become airborne.

Hazards of Ingestion: Small doses are not likely to produce symptoms. In cases where large doses have been ingested, symptoms are likely to include sweating of the hands and feet, numbness, loss of equilibrium, and a tingling sensation in the extremities.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Heating will likely contribute to the polymerization of acrylamide. Polymerization of solid acrylamide may be violent when heated to melting point. While ignition of acrylamide is unlikely, exposure to fire from other fuel sources may result in thermal decomposition. Aqueous acrylamide solution is non-flammable.

Hazardous Combustion Products: May produce oxides of carbon such as carbon monoxide, and ammonia.

EXPLOSION HAZARDS

Explosiveness: Solid will polymerize violently if in sealed container and heated sufficiently to induce polymerization.

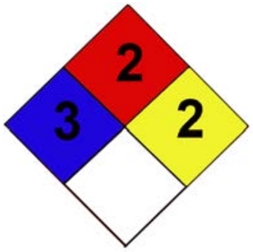
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Personal protective equipment should be selected to prevent direct skin or eye contact with acrylamide solutions or solid. For acrylamide solutions, equipment should be selected which is compatible with the solvent as well as acrylamide. For solid spills and aqueous solutions, equipment constructed of polyethylene, butyl, neoprene or nitril butadiene rubber has been reported as suitable. Gloves, chemical goggles, protective boots and protective coveralls should be used where potential for direct contact exists.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills. If acrylamide is in a solvent other than water, selection of respiratory protection should include consideration for solvent properties.

2074

ACRYLAMIDE
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Remove victim from source of contamination. Remove contaminated clothing and wash contaminated skin with water or soap and water. Watch for signs of neurological impairment and seek medical assistance immediately.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit.)

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Watch for signs of neurological impairment and seek medical assistance immediately.

First Aid for Ingestion: If victim is conscious, give water or milk and induce vomiting. Never give anything by mouth to, or induce vomiting in an unconscious person. Observe for signs of neurotoxic effects. Seek medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water is appropriate where acrylamide is involved. However, if acrylamide is involved in fire, it is likely that another material is providing the fuel. Select extinguishing materials appropriate to the buming material.

Extinguishing Techniques: Techniques selected should be appropriate for the burning material. Acrylamide is highly soluble and will dissolve in alcohol foams and water streams. Runoff will likely be contaminated.

SPILL RESPONSES

General Information: Restrict access to the area and avoid direct contact with spilled product. Prevent liquids and solids from entering sewers and waterways. If waterways are threatened, notify proper authorities, water and sewage treatment plant operators, and other down stream users of the potential for contaminated water. Protect spills, if possible, from contact with firefighting streams or other water sources to prevent solids from dissolving and becoming more mobile.

AIR SPILL

TECHNIQUE

COVER SPILLED SOLIDS . . . Air dispersion is not a significant problem with spills of solutions. Dusts from spilled solids may become airborne given sufficient wind velocity. Plastic tarps or other suitable covers can be used to protect the spill from wind erosion.

CONSEQUENCE

Tarps or other covering materials will become contaminated and require cleaning or disposal.

MITIGATION

Arrange for cleaning or disposal of contaminated cover materials.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of acrylamide solution on land may be contained by building dikes or barriers using soil, sand, or other materials. Where solids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

ACRYLAMIDE
Division 6.1 (Poisonous Material)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Acrylamide solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as firehose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking product.

CONSEQUENCE

Acrylamide solutions may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as firehose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools or dry solids may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION . . . Spilled liquids can be absorbed and immobilized with inert materials such as sand, earth, saw dust, vermiculite or compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with acrylamide solution and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL . . . Spilled acrylamide solids and contaminated soil may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use, with soap and water. Use equipment which is compatible with spilled product. Store recovered contaminated materials in a safe and secure location.

ACRYLAMIDE
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alterative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels..

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

September 2003

ACRYLIC ACID, STABILIZED

Class 8 (Corrosive Material)

GENERAL INFORMATION

Acrylic acid is a colorless liquid organic acid with a sharp, acrid, rancid odor that may be sweet but unpleasant. It is fully soluble and is shipped with an inhibitor, such as hydroquinone. The majority of acrylic acid manufactured is used to produce acrylic esters, such as methyl acrylate, butyl acrylate, ethyl acrylate and 2-ethylhexyl acrylate, which are later used to manufacture coatings, textiles, adhesives, paints and plastics. Reported flash points in the range of 118-138°F indicate that acrylic acid must be moderately heated or exposed to high ambient temperatures before ignition may occur easily. Nevertheless, accumulations of vapors in confined spaces such as sewers or buildings may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat (see below also) for sufficient time duration. The product weighs approximately 8.8 pounds per gallon.

Acrylic acid does not react with water or many other common materials but is corrosive to carbon steels, copper alloys, lead compounds and other substances. Although it is shipped containing an inhibitor, the product is not considered stable in normal transportation, since it may self-polymerize in a reaction that may violently or explosively rupture its container. Polymerization may occur at elevated temperatures or upon contact with acids, amines, ammonia, iron salts and various other chemicals. Polymerization may also occur if the product is permitted to freeze and then thaw without proper mixing to redistribute the inhibitor. The freezing point of acrylic acid is a relatively high 55.8°F. Toxicity of the product is high due to its corrosivity. Products of combustion may be toxic.

If container of acrylic acid is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in alcohol, chloroform and ether. Slightly soluble in acetone and benzene.

Specific Gravity (Liquid): 1.051 at 68°F (20°C)

Vapor Density: 2.5

Boiling Point: 285.8 - 287.6°F (141 - 142°C) at 1 atm

Melting Point: 53.6 - 57.2°F (12 - 14°C)

Freezing Point: 55.8°F (13.2°C)

Molecular Weight: 72.06

Heat of Combustion: - 4552 cal/g

Vapor Pressure: 3.1 mm Hg (0.06 psia) at 68°F (20°C) (Note: One manufacturer gives 8.7 mm Hg (0.168 psia))

Flash Point: 122°F (50°C), closed cup; 118 - 138°F (47.8 - 58.9°C), open cup

Autoignition Temperature: 774 - 820°F (412 - 438°C)

Burning Rate: 1.6 mm/minute

Flammable Limits: 2.4% (LFL) - 8% (UFL)

Stability: Normally unstable but will not detonate in normal transportation.

Polymerization Potential: Polymerization may occur if contaminated, heated, in low oxygen atmosphere or not inhibited. Light may promote polymerization once started.

pH: 2.6 (according to one source)

Corrosiveness: Corrosive to carbon steels, copper alloys, iron and lead compounds.

Reactivity with Water: No reaction

Reactivity and Incompatibility: May react with amines, alkalis, ammonia, acids, iron salts, azo and diazo compounds, hydrazines, caustics, cyanides, certain metals, nitrides, peroxides, phenols, explosives, cresols, inorganic sulfides and a wide variety of other substances.

IDENTIFICATION

Shipping Name(s): Acrylic acid, stabilized (USDOT & IMO)

Synonyms and Tradenames: Propenoic acid; Propene acid; Acroleic acid; Ethylene carboxylic acid; 2-Propenoic acid; Vinyl formic acid; Glacial acrylic acid; GAA.

CAS Registry No.: 79-10-7

Chemical Formula: $CH_2CHCOOH$

Constituent Components (% each): 94% to 99.5% pure with small amount of water and inhibitor like monomethylether of hydroquinone

UN/NA Designation: UN2218

IMO Designation: 8, Corrosive substances

RTECS Number: AS4375000

NFPA 704 Hazard Rating: 3 (Health): 2 (Flammability): 2 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid, but will solidify at 56°F

Color of the Shipped Material: Colorless

Odor Characteristics: sharp; acrid; rancid; sweet but unpleasant

Reportable Quantity: See appendix I

Common Uses: Mfg. of plastics, paints, leather and paper coatings, rubber, photographic chemicals; soil conditioner or binder; fiber sizing.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ACRYLIC ACID, STABILIZED

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1.04 (reported by one source)

Unusual Hazards: Product is normally unstable and may self-polymerize in a violent reaction under appropriate conditions. There is a special hazard upon freezing and thawing. (See General Information section for details.)

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 2 ppm (6 mg/m^3) (ACGIH)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Exposure to temperatures less than 59°F or greater than 77°F; contact with excessive heat, ignition sources, or incompatible materials; runoff to water or sewers; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Acrylic acid is corrosive and toxic to tissue via all routes of exposure.

Hazards of Skin or Eye Contact: Contact with liquid acrylic acid may cause moderate to severe burns of the skin or eyes within moments. The skin may be sensitized and a rash may occur. Absorption through the skin may cause systematic illness with nausea and vomiting as symptoms.

Hazards of Inhalation: Vapors of acrylic acid are very irritating to the eyes, skin and mucous membranes of the respiratory tract.

Hazards of Ingestion: Ingestion of acrylic acid may cause severe intestinal burns and damage to the gastrointestinal tract.

FIRE HAZARDS

Lower Flammable Limit: 2.4%

Upper Flammable Limit: 8%

Behavior in Fire: Combustible liquid. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well defined; may include toxic fumes carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

Lower Explosive Limit: 2.4% (technical); 2% (glacial)

Upper Explosive Limit: 8.0% (glacial)

Explosive Potential: Explosion may result if vapors of warm liquid are ignited in a confined area. Loss of inhibitor or excessive heat may cause violent container rupture due to spontaneous violent polymerization. Polymerization may also occur in presence of amines, acids, ammonia, iron salts and various other chemicals, or if the product is improperly thawed after freezing.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

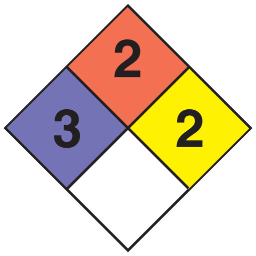
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Compatible materials include chlorinated polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

2218

ACRYLIC ACID, STABILIZED

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation of eyes, skin or mucous membranes.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, alcohol-resistant foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Remove all sources of heat, sparks, or open flames. Choose equipment that is not corroded or otherwise damaged by the spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Avoid contact with spilled product. Keep unprotected personnel upwind of spill area. Take into account that acrylic acid may polymerize under the conditions described in the General Information section.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Acrylic acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of acrylic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

ACRYLIC ACID, STABILIZED
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acrylic acid vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain acrylic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of acrylic acid vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid acrylic acid may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid acrylic acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Acrylic acid may be contained by building dikes using soil, dry sand or other materials.

CONSEQUENCE

Contained acrylic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

ACRYLIC ACID, STABILIZED
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

ACRYLIC ACID, STABILIZED
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

September 2003

ACRYLONITRILE, STABILIZED

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Acrylonitrile is a colorless liquid with a pungent odor resembling onion, garlic or peach pit kernels. It is used to make plastics, fibers, surfactants, rubber, adhesives and other chemicals and products and also has uses as a pesticide. It is moderately soluble in water and lighter, so may be expected to form a floating surface slick that dissolves fairly rapidly. Its flash point of 30°F indicates that it is easily ignited under many ambient temperature conditions. The product is moderately volatile and may at times (when warm) evolve vapors that are somewhat heavier than air. These may travel to a source of ignition and flash back. Accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 6.7 pounds per gallon.

Acrylonitrile does not react with water and is stable in normal transportation when inhibited against self-polymerization. Nevertheless, potentially violent polymerization may occur in containers upon exposure to excessive heat, alkaline materials or acids. The product attacks copper, copper alloys and aluminum and is capable of penetrating leather shoes or gloves. It is a highly toxic material that resembles hydrogen cyanide in toxic effects. Products of combustion may include toxic hydrogen cyanide gas and oxides of nitrogen.

Initial downwind evacuation should be considered if acrylonitrile is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Moderately soluble, 8 g/100 g water at 70°F (21.1°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene and ether.

Specific Gravity (Liquid): 0.8074 at 68°F (20°C)

Vapor Density: 1.8

Boiling Point: 171.3 – 172.2°F (77.4 – 77.9°C) at 1 atm

Melting Point: – 118.3°F (– 83.5°C)

Freezing Point: – 118.3°F (– 83.5°C)

Molecular Weight: 53.06

Heat of Combustion: – 7930 cal/g

Evaporation Rate (butyl acetate=1): One source reports 10

Vapor Pressure: 83 mm Hg (1.60 psia) at 68°F (20°C); 100 mm Hg (1.93 psia) at 73°F (22.8°C)

Flash Point: 30°F (– 1.1°C), closed cup; 31 – 32°F (–.6 to 0°C), open cup

Autoignition Temperature: 898°F (481.1°C)

Burning Rate: Unavailable

Flammable Limits: 3.0% (LFL) - 17% (UFL)

Stability: Stable when inhibited in normal transportation.

Polymerization Potential: May polymerize spontaneously without inhibitor or when heated or in presence of strong alkali.

Corrosiveness: Corrosive to copper, copper alloys, brass and aluminum.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with strong acids, sodium hydroxide, potassium hydroxide, ammonia, other strong bases and amines.

IDENTIFICATION

Shipping Name(s): Acrylonitrile, stabilized (USDOT & IMO)

Synonyms and Tradenames: 2-propenenitrile; Cyanoethylene; Vinyl cyanide; Propene nitrile; Acritet; Acrylon; Acrylonitrile monomer; Carbacryl; Fumigrain; Millers Fumigrain; Ventox; ACN; AN; VCN.

CAS Registry No.: 107-13-1

Chemical Formula: CH_2CHCN

Constituent Components (% each): 98–100% pure with trace of inhibitor like methylhydroquinone.

UN/NA Designation: UN1093

IMO Designation: 3, Flammable liquids

RTECS Number: AT5250000

NFPA 704 Hazard Rating: 4 (Health): 3 (Flammability): 2 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless or light yellow.

Odor Characteristics: Mild, pungent, like onion, garlic or peach pit kernels.

Reportable Quantity: See appendix I

Common Uses: Pesticide; mfg. of plastics, fibers, rubber, adhesives, pharmaceuticals, dyes, surfactants and other products and chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ACRYLONITRILE, STABILIZED

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.0031–50.4 ppm; reported values vary

Unusual Hazards: May polymerize violently if heated or contaminated. Recognized as having carcinogenic potential for humans. May emit highly toxic hydrogen cyanide gas when heated or burned. Vapors are uninhibited and may form polymers in vents or flame arrestors, resulting in blockage.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): (Skin) 2 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Ceiling (C) Limit: 10 ppm

IDLH: 85 ppm

Conditions to Avoid: Heat, fire and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of vapors in air. Ingestion and physical contact are also to be strictly avoided. Product is suspected of being carcinogenic in long-term exposures based on animal studies.

Hazards of Skin or Eye Contact: Prolonged skin contact with liquid acrylonitrile, as may occur by contact with contaminated leather or clothing, may result in formation of large blisters after several hours. Although there is little or no pain, affected skin resembles second degree burn. Effects are minor if the liquid is allowed to evaporate from exposed skin. Contact with the eyes may cause severe irritation. (Note: Acrylonitrile may also be absorbed through the skin in toxic amounts with symptoms similar to those of inhalation.)

Hazards of Inhalation: Vapors of acrylonitrile may cause eye irritation, headache, sneezing, nausea, weakness, flushed face, shallow breathing, salivation, sensitivity to light and vomiting. High concentrations may cause profound weakness, asphyxia, collapse and possibly death. Effects resemble serious hydrogen cyanide poisoning and may be delayed for several hours. Concentrations of 500 – 600 ppm are lethal to various animals within 4 hours in laboratory experiments.

Hazards of Ingestion: Ingestion may cause nausea, vomiting, abdominal pain and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 3.0%

Upper Flammable Limit: 17%

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas, and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable and toxic vapors upon release.

Hazardous Combustion Products: May include hydrogen cyanide, nitrogen oxides and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Loss of inhibitor or excessive heat or light may cause spontaneous violent polymerization resulting in violent container rupture. Violent polymerization may also occur in the presence of alkaline materials or acids.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

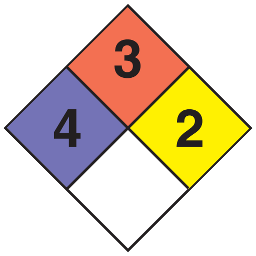
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber which is reported to have a greater than 8 hour breakthrough time. Tychem® QC, Tychem® SL, Tychem® 7500, Tychem® 9400, Tychem® BR, Tychem® 10,000 and Tychem® TK are reported to have greater than 8 hour normalized breakthrough times. Do not use leather items.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister (100 ppm or less) or an organic vapor cartridge respirator with a full facepiece (100 ppm or less) within the use limitations of these devices.

1093

ACRYLONITRILE, STABILIZED

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Eye irritation and other symptoms of inhalation, ingestion or physical contact. Keep victim under medical surveillance for delayed effects of cyanide poisoning (48–72 hours).

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious or breathing difficult, administer artificial respiration. For cyanide poisoning, administer amyl nitrite by crushing pearl in a cloth and lightly holding under nose for 15 seconds. Repeat 5 times at 15 second intervals. Use a fresh pearl every 5 minutes as necessary for 3–4 pearls. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Administer amyl nitrite as described above if victim is unconscious.)

Note to Physician: Use Amyl nitrate capsules if symptoms develop. Medical personnel trained in cyanide poisoning should be available.

FIRE RESPONSE

Extinguishing Agents: Alcohol foam, dry chemical, carbon dioxide, water fog. Water may be ineffective but large quantities may be used to dilute spills to nonflammable mixtures. Note that 2% solution still has a flash point of 70°F.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Acrylonitrile may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Acrylonitrile is a highly flammable liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that acrylonitrile is a moderately volatile, highly flammable, and highly toxic substance with limited solubility in water. Acrylonitrile may float on top of water. Violent polymerization may occur under conditions described in the General Information section.

ACRYLONITRILE, STABILIZED

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of acrylonitrile from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Alcohol resistant foam applied to the surface of liquid pools may slow the release of acrylonitrile vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Acrylonitrile may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained acrylonitrile may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ACRYLONITRILE, STABILIZED

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ACRYLONITRILE, STABILIZED
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels. (Note: Oil spill containment and cleanup techniques may be useful in the early stages of the response before acrylonitrile dissolves in water.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ADIPIC ACID

Class 9 (Miscellaneous Hazardous Material)

GENERAL INFORMATION

Adipic acid is a white, odorless, crystalline solid used to make plastics, foams, food additives, and other products. Its flash point is generally given to be in the high range of 376-385°F, but its dust may form explosive mixtures in air. The product is slightly soluble and heavier than water and will therefore sink and slowly dissolve to form an acidic solution. The density of adipic acid is slightly less than 85 pounds per cubic foot.

Adipic acid does not react with water, may be mildly corrosive to certain materials, and is incompatible with a variety of other chemicals. It is relatively stable in normal transportation and of generally low toxicity, although it is an irritant via direct contact or inhalation. Products of combustion are irritating and may include cyclopentane and carbon monoxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 1.9 g/l00g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether (slight), and acetone.

Specific Gravity (Liquid): 1.07 at 338°F (170°C); solid is 1.36 at 77°F (25°C)

Boiling Point: Decomposes at about 626°F (330°C) at 1 atm.

Melting Point: 303.8-307.4°F (151-153°C)

Freezing Point: 304°F (151°C)

Molecular Weight: 146.14

Heat of Combustion: –4579 cal/g

Vapor Pressure: 0.073 mm Hg (0.001 psia) at 65°F (18.5°C)

Flash Point: 376-385°F (191.1-196.1°C)

Autoignition Temperature: 788°F (420°C)

Burning Rate: Not pertinent.

Stability: Relatively stable.

Corrosiveness: May be mildly corrosive to industrial equipment.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with cyanides, dithiocarbamates, inorganic fluorides or sulfides, strong oxidizing agents, certain metals, nitrides, strong reducing agents, explosives, alcohols and glycols, aldehydes, epoxides, polymerizable compounds, amines, azo and diazo compounds, hydrazines, caustics, nitriles, and isocyanates.

IDENTIFICATION

Shipping Names: Environmentally Hazardous Substances, Solid, N.O.S. (USDOT) Adipic acid (Canada)

Synonyms and Tradenames: Hexanedioc acid; adipinic acid; 1,4-butanedicarboxylic acid; acifloctin; acinetten; adilactetten; 1,6-hexanedioc acid; molten adipic acid

Chemical Formula: $HOOC(CH_2)_4COOH$

Constituent Components(% each): 99.5-99.8% pure; rest mainly water

UN/NA Designation: UN3077 (USDOT)

IMO Designation: Not listed.

Physical State as Shipped: Monoclinic crystals (needles) or powder

Physical State as Released: Solid

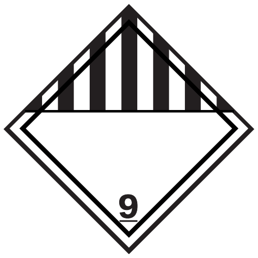
Color of the Shipped Material: White

Odor Characteristics: Essentially odorless

Common Uses: Mfg. of nylon, plastics, urethane foam, synthetic resins, adhesives and elastomers; food additive (acidulant).

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ADIPIC ACID
Class 9
(Miscellaneous Hazardous Material)



POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Dust of adipic acid can form explosive mixtures at concentrations at or above 10-15 mg per liter in air.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Dust concentrations in air within explosive limits; exposure to excessive heat or fire; runoff to water or sewers; contact with incompatible materials; excessive inhalation of dusts; direct physical contact with eyes or skin.

HEALTH HAZARDS

Public Health Hazards: General hazard is low unless there are excessive concentrations of dust in air or direct physical contact is permitted.

Hazards of Skin or Eye Contact: Contact with adipic acid may cause some degree of irritation of the eyes or skin. Skin effects due to working with this chemical commonly occur in areas of wrists, neck, and ankles.

Hazards of Inhalation: Breathing adipic acid dust may cause irritation or burns to the membranes of the nose and throat.

Hazards of Ingestion: Adipic acid is considered to be of low toxicity by ingestion in single doses. It is used as a food additive.

FIRE HAZARDS

Lower Flammable Limit: 10-15 mg dust per liter of air

Upper Flammable Limit: Unavailable

Behavior in Fire: Will burn but difficult to ignite. Very high temperatures will melt and possibly decompose adipic acid. Products of decomposition include volatile acidic vapors of valeric acid and other substances.

Hazardous Combustion Products: Irritating; may include cyclopentane, carbon monoxide, and other products.

EXPLOSION HAZARDS

Lower Explosive Limit: 10-15 mg dust per liter of air

Upper Explosive Limit: Unavailable

Explosiveness: Dust may form explosive mixtures with air at certain concentrations. Contact with alcohols and glycols, aldehydes, epoxides and polymerizable compounds may result in possibly violent polymerization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, aprons, dust-tight safety goggles, and other impervious and resistant clothing for handling finely divided solids. Compatible materials may include neoprene, nitrile rubber, polyvinyl chloride, natural rubber, and several other substances.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For normal exposure in dusty conditions, a particulate respirator with either a full or half facepiece.

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, and mucous membranes of the nose and throat.

First Aid for Inhalation: Remove victim to fresh air. Get medical attention.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation develops.

First Aid for Ingestion: Information unavailable. Product is of low oral toxicity but seeking of immediate medical attention is prudent.

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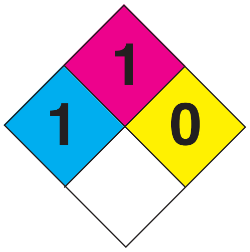
ADIPIC ACID
Class 9
(Miscellaneous Hazardous Material)



FIRE RESPONSE

Extinguishing Materials: Water fog, carbon dioxide, dry chemical, alcohol foam.

Extinguishing Techniques: Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Do not extinguish burning cargo unless flow can be stopped safely. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Keep unprotected personnel upwind of spill area. Protect sewers and waterways from contamination. Avoid contact with spilled product. Take into account while planning the response that the dust of adipic acid may form explosive mixtures with air.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Adipic acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of adipic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid adipic acid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Solid adipic acid or its solutions in water may be contained by building dikes using earth, sand or similar materials.

CONSEQUENCE

Solutions in water may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Protect solid product from becoming wet. Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments.Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain solid adipic acid or its solution in water.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ADIPIC ACID

Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of liquid solutions may be controlled by absorbing liquid with sand, earth, clay, fly ash, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed material may result in future spread of contamination. Agitation of dry solid product may cause flammable or explosive dust concentrations in air.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water and slowly dissolve. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spreading of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

ADIPIC ACID
Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where spilled product has accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

ADIPONITRILE*

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Adiponitrile is a high boiling, odorless and colorless poisonous liquid derived from the chlorination of butadiene to dichlorobutylene, which is reacted with 35% sodium cyanide solution to yield 1,4-Dicyanobutylene, which is hydrogenated to adiponitrile. Adiponitrile may also be produced from the electroorganic synthesis from acrylonitrile. Adiponitrile is generally used as a chemical intermediate in the manufacturing process for hexamethylenediamine to make nylon, corrosion inhibitors, and rubber accelerators. It is also used to produce adipoguanamine resins.

The typical concentration of adiponitrile is 99.9%. Adiponitrile is a skin, eye, nose and throat irritant. The most common route of exposure is through skin contact. It is highly toxic by skin absorption, inhalation and ingestion. Poisoning by adiponitrile resembles poisoning by hydrocyanic acid. Although the metabolic fate of this compound is not completely known, some nitriles are partially metabolized to hydrogen cyanide. Personnel exposed may need to be treated for cyanide poisoning.

The fire potential for adiponitrile is moderate, however, when heated the material may release ignitable vapors and form explosive mixtures with air. Polymerization will not occur. The products of combustion may be more hazardous than the material itself. When heated to decomposition, the burning material may generate extremely hazardous gases such as hydrogen cyanide and carbon monoxide. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for working in atmospheres where adiponitrile is present. Runoff may be toxic. Adiponitrile is water soluble. Adiponitrile is normally stable, however it is incompatible with strong oxidizers such as acids, acid salts, chlorates and nitrates.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble
Solubility in Other Chemicals: alcohol, chloroform, chloroalkanes and aromatics.
Specific Gravity (Liquid): 0.97 @ 20°C (68°F)
Vapor Density (Air=1): 3.73
Boiling Point: 295°C (563°F)
Melting Point: 1°C (34°F)
Freezing Point: 2.3°C (36°F)
Molecular Weight: 108.16
Heat of Combustion: -14,230 BTU/LB = -7910 CAL/G
Vapor Pressure: 0.01 mm Hg at 40°C (104°F)
Flash Point: 163°C (325°F)
Autoignition Temperature: 550°C (1022°F)
Flammable Limits: 1.0% (LEL) - 5.0% (UEL)
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with strong oxidizers such as acids, acid salts, chlorates, and nitrates.
Other Characteristics: Vapor forms explosive mixtures with air. When heated to decomposition, material releases vapors containing hydrocyanic acid.

IDENTIFICATION

Shipping Name(s): Adiponitrile (USDOT & IMO)
Synonyms and Tradenames: Hexanedinitrile, Adipic Nitrile, Adipic Acid Dinitrile, Adipic Acid Nitrile, 1,4-Dicyanobutane, ADN, Hexanedioic Acid Dinitrile Tetramethylene Cyanide, Tetramethylene Dicyanide. CAS Registry No: 111-69-3
Chemical Formula: $NC(CH_2)_4CN$
Molecular Formula: $C_6H_8N_2$
Constituent Components (% each): adiponitrile (99.9), water (0.05) and other organics (0.2).
UN/NA Designation: UN2205
IMO Designation: 6.1
RTECS Number: NIOSH/AV2625000
OHMTADS Number: 7216576
NFPA 704 Hazard Rating: 4 (Health): 2 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless/clear
Odor Characteristics: Odorless
Common Uses: Chemical intermediate used in the manufacture of hexamethylenediamine to make nylon, corrosion inhibitors, rubber accelerators and resins.

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*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ADIPONITRILE
Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: <1 ppm

Unusual Hazards: Products of combustion may be more hazardous than the material itself. Material is immediately irritating to the eyes when released into the atmosphere. Personnel should not wear contact lenses when working in contaminated areas.

Time Weighted Average (TLV-TWA): 2 ppm

Short Term Exposure Limit (STEL): Unavailable.

IDLH: Unavailable.

Conditions to Avoid: Heat, sparks, flame, incompatible materials, such as strong oxidizers, runoff to sewers and waterways, skin contact, inhalation and ingestion. Material may not be stored near food stuffs.

HEALTH HAZARDS

Potential Health Effects: Adiponitrile is a skin, eye, nose and throat irritant. May be fatal if absorbed through the skin or inhaled in toxic amounts. Liquid and vapor can penetrate skin and mucous membranes. May cause severe allergic respiratory reaction. Gross overexposure may be fatal. Individuals with preexisting diseases of the cardiovascular system or bone marrow may have increased susceptibility to the toxicity of excessive exposures. Although the metabolic fate of this compound is not completely known, some nitriles are partially metabolized to cyanide. Symptoms may be delayed. If over exposed, treatment for cyanide intoxication may be indicated.

Hazards of Skin and Eye Contact: Skin contact may cause skin irritation with discomfort or rash. Evidence suggests that skin permeation can occur in amounts capable of producing systemic toxicity. Prolonged exposures may lead to skin burns or ulceration. Eye contact may cause irritation, tearing, or blurred vision. Prolonged exposure can cause skin burns or ulceration, and eye corrosion with corneal and conjunctival ulceration.

Inhalation Hazards: Inhalation may cause central nervous system (CNS) effects such as nausea, headache, dizziness or general weakness. Irritation of the upper respiratory tract and temporary alteration of the heart’s electrical activity with irregular pulse, palpitations, or inadequate circulation may also occur.

Ingestion Hazards: Ingestion may cause irritation and potential ulceration of the respiratory tract, followed by headache, nausea, vomiting and cyanosis.

FIRE HAZARDS

Lower Flammable Limit: 1.0%

Upper Flammable Limit: 5.0%

Behavior in Fire: Although it will not readily ignite, adiponitrile will burn if exposed to sources of heat and flame.

Hazardous Decomposition Products: When heated to decomposition, adiponitrile releases vapors containing hydrocyanic acid. Hazardous gases and vapors produced in fire situations also include unsaturated nitriles and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Vapors may form explosive mixtures with air. Containers may explode violently in the heat of fire.

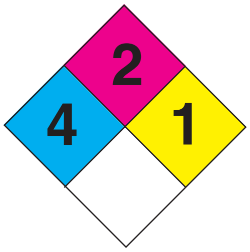
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Fully encapsulating, vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are teflon and butyl rubber. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits.

FIRST AID

Nonspecific Symptoms: Direct skin contact can produce irritation, inflammation, burns, and ulceration of tissue. Central nervous system (CNS) effects may include nausea, headache, dizziness or general weakness. The material is known to be a mucous membrane irritant. Other symptoms may include vertigo, cyanosis of the mucosa, tachypnea, hypotension, mydriasis, and clonic



convulsions of the extremities.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCTATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if in place. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. DO NOT GIVE SYRUP OF IPECAC. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Special Medical Treatment Information for Physicians: Due to the possibility that some nitrile compounds metabolize to cyanide, treatment for cyanide intoxication may be required in some situations. Rapid support of respiration and circulation is essential to the successful treatment of cyanide intoxication. Immediate attention should be directed towards assisted ventilation, administration of 100% oxygen, insertion of intravenous (IV) lines, and institution of cardiac monitoring. Obtain an arterial blood gas immediately and correct any severe metabolic acidosis (pH below 7.15). If the patient is conscious but symptoms (i.e., nausea, difficulty breathing, dizziness, etc.) are evident, administer oxygen. If consciousness is impaired (i.e., non-responsiveness, slurred speech, confusion, drowsiness, etc.), or the patient is unconscious but breathing, give oxygen and amyl nitrite by means of a respirator. Administer oxygen continuously. Guard against the ampoule entering the patient's mouth. If the patient is not breathing, give oxygen and amyl nitrite immediately by means of a positive pressure respirator. Treat what you see is a good rule of thumb. Mildly symptomatic patients may be managed by supportive care only.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray, AFFF multi-purpose foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water spray to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be poisonous and/or toxic.

SPILL RESPONSES

General Information: Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and down wind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways and storm drains. Underflow dams are not an effective means to dike material since it mixes with water. As a result, recovery efforts from water borne releases are difficult. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...If released into the atmosphere, adiponitrile is expected to exist almost entirely in the vapor phase. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

FOAM...Aqueous Film Forming Foam (AFFF) or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, storm drains and waterways. Contain foam runoff and treat as hazardous waste.

ADIPONITRILE

Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material readily mixes with water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms are not an effective means to recover spilled material since the material is water soluble. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material is water soluble and the material does not float on the surface of the water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

ADIPONITRILE

Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering storm and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

September 2003

ALCOHOL ETHOXYLATES

Class 9 (Miscellaneous hazardous material)

GENERAL INFORMATION

Alcohol ethoxylates (AEs) are nonionic surfactants composed of an alkyl chain (typically 12 to 15 carbons) combined with some ethylene oxide (EO) units. Alcohol ethoxylate solutions contain a mixture of varying length carbon chain alcohol ethoxylate molecules (the number of carbon atoms contained in the longest direct line). The solution is named for the predominant AE carbon chain length and will be reported as a range, such as alcohol C12-C15 poly (1-3) ethoxylate. Because this guide covers a variety of alcohol ethoxylates, many of the physical properties are reported as ranges.

Alcohol ethoxylates are clear to milky white (possibly yellow) liquids that are often reported to be viscous or semi-solid at room temperature and have a slight, ether-like odor. AEs are soluble in water, however, solubility decreases with increasing carbon chain length while increasing with higher EO percent. The greatest use of AEs are in the formation of consumer and industrial detergents, wetting or foaming agents, dispersants and penetrants and personal care products. Product is a marine pollutant, the toxicity of which is dependent on the alkyl chain length and the number of EOs. AE's will not readily ignite but may burn if preheated. Ethylene oxide vapors may evolve and collect in enclosed containers and may be flammable. Contact with strong oxidizing agents and acids should be avoided. The product weighs approximately 7.7 to 8.5 pounds per gallon.

Alcohol ethoxylates are not expected to evolve large amounts of vapor as they have a low vapor pressure and a high boiling point. Main routes of exposure are expected to be skin or eye contact, however, consideration should be given to the fact that the product may contain flammable and toxic ethylene oxide. Vapors are heavier than air. If container of alcohol ethoxylates is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): .925 to 1.02 at 77°F (25°C)
Vapor Density: Varies, heavier than air. Generally reported in the range of 11 to 19.
Boiling Point: No definitive values reported. Reported values have been >212°F (100°C) and >500°F (260°C).
Melting Point: See freezing point
Freezing Point: 25-75°F (-4 to 24°C)
Molecular Weight: Varies
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): Unavailable
Vapor Pressure: < 0.1 mm Hg at 100°F (38°C)
Flash Point: Approximately 320°F (160°C)
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Flammable Limits: Unavailable
Stability: Stable under normal conditions
Polymerization Potential: Will not occur
pH: 5 - 7
Corrosiveness: May react with aluminum (metal) at temperatures above 122°F (50°C) resulting in metal corrosion.
Reactivity with Water: None
Reactivity and Incompatibility: Avoid strong oxidizing agents; in presence of strong acids may undergo acid catalyzed dehydration of the alcohol to produce alkenes and cleavage of the ether bonds.

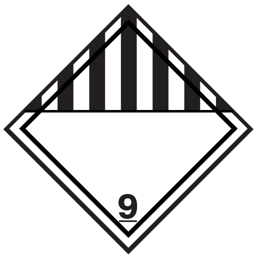
IDENTIFICATION

Shipping Name(s): The technical name (or chemical name) that appears in parenthesis immediately following the shipping description (Environmentally hazardous substances, liquid, n.o.s.) for any of the alcohol ethoxylates will be within the numerical range of alcohol C-12-C-17 poly (1-6) ethoxylate. Example: Environmentally hazardous substances, liquid, n.o.s. (Alcohol (C12-C15) poly (1-3) ethoxylate) (USDOT & IMO)
Synonyms and Tradenames: Ethoxylated alcohols; NEODOL®; BIO-SOFT®
CAS Registry No.: Products fall under a variety of CAS numbers. Some include 63393-82-8; 66455-14-9; 68131-39-5 or 68551-12-2
Chemical Formula: Varies, $CH_3(CH_2)_a(CH_2CH_2O)_bOH$
Constituent Components (% each): Generally 90% or greater pure
UN/NA Designation: UN3082
IMO Designation: 9, Miscellaneous dangerous substances and articles
RTECS Number: TH3675000
NFPA 704 Hazard Rating: 2 (Health): 1 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid, possibly viscous
Physical Form as Released: Liquid, possibly viscous
Color of the Shipped Material: Clear to slightly hazy, may be yellow
Odor Characteristics: Slight, ether like
Common Uses: Basic surface active agent for detergents. Formulation of products where wetting and biodegradability are essential, i.e., specialty formulations for textile processing, hard surface abrasives and metal descaling.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ALCOHOL ETHOXYLATES

Class 9 (Miscellaneous hazardous material)



POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Product is a marine pollutant. Alcohol ethoxylates may contain residual amounts of ethylene oxide, a flammable and toxic gas, which can accumulate in the container headspace and be released. The process is enhanced by agitation of the product, such as loading and unloading.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable for alcohol ethoxylates. However, alcohol ethoxylates may contain residual amounts of ethylene oxide. OSHA regulates occupational exposure to ethylene oxide from all sources, including products containing residual EO. The current OSHA PEL is 1 ppm for ethylene oxide.

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: May cause irritation to the eyes, skin and respiratory system.

Hazards of Skin or Eye Contact: Severely irritating to the eyes causing pain, redness, swelling and blurred vision.

Hazards of Inhalation: May cause irritation of the nose and throat, headache and drowsiness.

Hazards of Ingestion: Ingestion may produce gastrointestinal disturbances including irritation, nausea and diarrhea.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: May burn if preheated but will not readily ignite. When ethoxylates are vigorously mixed in the presence of air or oxygen at temperatures > 325° F, they can cause exothermic oxidative degradation which may result in self-heating and autoignition. Ethylene oxide, an extremely flammable and toxic gas may evolve and collect in enclosed containers.

Hazardous Combustion Products: Toxic levels of carbon monoxide, carbon dioxide, irritating aldehydes and ketones may be formed.

EXPLOSION HAZARDS

Explosive Potential: Product is not expected to present an explosion hazard.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

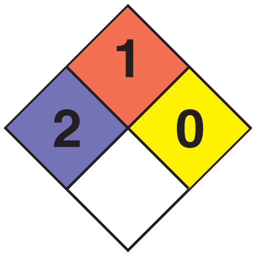
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use of limitations of these devices. If occupational exposure may exceed 1 pmm ethylene oxide, a respirator is required.

3082

ALCOHOL ETHOXYLATES

Class 9 (Miscellaneous hazardous material)



FIRST AID

Nonspecific Symptoms: Irritation of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately if breathing is difficult or has stopped or if irritation persists. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician if skin irritation develops or persists. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Ethoxylates are combustible liquids. Appropriate extinguishing agents may include dry chemical, carbon dioxide, water spray or alcohol resistant foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool.

SPILL RESPONSES

General Information: Alcohol ethoxylates are marine pollutants that may cause environmental contamination. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment where necessary. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. NOTE: Alcohol ethoxylates may contain residual amounts of ethylene oxide, a flammable and toxic material, spills should be monitored for the presence of ethylene oxide.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists. NOTE: Residual amounts of ethylene oxide may be present in alcohol ethoxylate solutions, and as such, continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

ALCOHOL ETHOXYLATES

Class 9 (Miscellaneous hazardous material)

TECHNIQUE

WATER FOG OR SPRAY . . . Vapor generation from alcohol ethoxylate spills may not be sufficient to warrant fog or spray applications. If vapors or fumes present a threat, water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of toxic vapors from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Vapor generation from alcohol ethoxylate spills may not be sufficient to warrant foam applications. Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Alcohol ethoxylates may be confined by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Confined liquid may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

ALCOHOL ETHOXYLATES
Class 9 (Miscellaneous hazardous material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination. NOTE: Alcohol ethoxylates are marine pollutants.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ALCOHOL ETHOXYLATES

Class 9 (Miscellaneous hazardous material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1994

ALLYL ALCOHOL*
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Allyl alcohol is a colorless liquid with a sharp, pungent, mustard-like odor that is highly irritating. Its vapors can bring tears to the eyes even at fairly low concentrations in the air. Allyl alcohol can be easily ignited under warm ambient temperature conditions. Under these conditions, vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings and sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration.

Allyl alcohol is completely soluble in water. It does not react with water or other common materials but it is incompatible with oxidizing materials. As with most organic materials, contact with oxidizing agents may cause ignition. Allyl alcohol is stable in normal transportation and is not subject to violent polymerization.

Allyl alcohol is toxic by all routes of exposure and is rapidly absorbed through the skin in harmful amounts. It is considered highly toxic by ingestion and will produce systemic effects. As with most alcohols, target organs include liver, kidneys, and nervous system. Toxic fumes are evolved upon heating of the product.

If allyl alcohol is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris should the container rupture violently.

Allyl alcohol is used to make a variety of products including flavoring agents, glycerin, pharmaceuticals, herbicides and fungicides. It weighs approximately 7.1 pounds per gallon.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in alcohol, chloroform, ether, and petroleum ether.

Specific Gravity (liquid): 0.85 at 68°F (20°C)

Vapor Density (Air = 1): 2.0

Boiling Point: 204.8 to 208.4°F (96 - 98°C)

Melting Point: - 200°F (- 129°C)

Freezing Point: - 200°F (- 129°C)

Molecular Weight: 58.08

Heat of Combustion: - 7620 cal/g

Vapor Pressure: Approximately 17.2 mm Hg (0.3325 psia) at 68°F (20°C)

Flash Point: 70 to 75°F (21.1 - 23.9°C), CC; 90°F (32.2°C), OC

Autoignition Temperature: 713°F (378°C)

Burning Rate: 2.7 mm/minute.

Stability: Stable at ordinary temperatures and pressures.

Corrosiveness: Non-corrosive to steel but may attack some forms of plastics, rubber, and coatings. Not compatible with certain metals listed below.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: May react with carbon tetrachloride, sodium, potassium, sulfuric acid, chlorosulfonic acid, nitric acid, oleum, sodium hydroxide, diallyl phosphite, phosphorus trichloride, tri-n-bromomelamine, oxidizing agents, magnesium and aluminum and their alloys, metal alkyls, and reactive metal halides such as aluminum chloride and ferric chloride.

IDENTIFICATION

Shipping Names: Allyl alcohol (USDOT and IMO).

Synonyms and Tradenames: 2-propen-l-ol; 1-propenol-3; propen-l-ol-3; allylic alcohol; propenyl alcohol; vinyl carbinol; hydroxypropene; propenol; CAS 107-18-6.

Chemical Formula: CH_2CHCH_20H

Constituent Components (% each): 98% or more pure with small amounts of propanol, water, and propionaldehyde.

UN/NA Designation: UN1098.

IMO Designation: 6.1, poisonous material.

Physical State as Shipped: Liquid.

Physical State as Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Pungent; mustard-like; sharp, causes tears.

Common Uses: Manufacture of allyl compounds, military poison gas, resins, plasticizers, pharmaceuticals, herbicides, fungicides, and other organic chemicals. Also used as a flavoring agent in making glycerin.

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*Reportable Quantity (RQ) established. Refer to appendix I.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ALLYL ALCOHOL
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.75 - 0.8 ppm (1.875 - 2 mg/m^3)

Unusual Hazards: A toxic, volatile, and flammable liquid. Allyl alcohol is toxic by all routes of exposure. Vapors may travel some distance to a source of ignition and flash back, particularly at warmer temperatures. The product is subject to slow polymerization and may form a thick, viscous liquid upon storage for several years.

Short Term Exposure Limits (STEL): (Skin) 4 ppm (10 mg/m^3). (OSHA)

Time Weighted Average (TLV-TWA): (Skin) 2 ppm (5 mg/m^3) over each 8 hours of a 40 hour work week. (OSHA)

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Allyl alcohol is toxic by all routes of exposure. Vapors are toxic and highly irritating. Increasing ambient temperature will increase the rate of vapor evolution. Ingestion may result in systemic poisoning effects particularly targeting liver function. Allyl alcohol is readily absorbed through intact skin.

Hazards of Skin and Eye Contact: Allyl alcohol exposures to skin tissues may result in a delayed effect which produces deep pain several hours after exposure. This is usually followed by blister formation and localized swelling coupled with muscle spasms. The liquid is rapidly absorbed through intact skin and may result in additional toxic effects involving the kidneys and liver. Eye exposures to allyl alcohol may result in a moderate to severe irritation reaction with transient opacity of the cornea. Recovery is usually prompt except in severe exposures.

Hazards of Inhalation: Vapors of allyl alcohol are highly irritating to the eyes, nose, and throat and may cause delayed eye pain and increased sensitivity to light. High concentrations in air may cause nausea, vomiting, and lung irritation or hemorrhage leading to delayed pulmonary edema. Liver injury and death are possible in severe exposures. Other symptoms may include alcoholic intoxication, decrease in blood sugar, decrease in body temperature, convulsions, coma, slowed breathing, and unconsciousness. Effects may be delayed and progressive.

Hazards of Ingestion: Allyl alcohol is considered highly toxic by ingestion. Target organs of toxic action include liver, heart, spleen, and kidneys. In cases involving high exposures, symptoms of alcohol intoxication may develop, however, symptoms may grow progressively worse resulting in coma and possible death. Other symptoms may include nausea, vomiting, and signs of central nervous system depression.

FIRE HAZARDS

Lower Flammable Limit: 2.5%

Upper Flammable Limit: 18%

Behavior in Fire: Flammable, toxic vapors may travel some distance to a source of ignition and flash back, particularly at warmer temperatures. Containers may rupture violently in fire.

Hazardous Combustion Products: Toxic fumes are evolved upon heating of allyl alcohol.

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire. Mixtures with tri-n-bromomelamine may result in a delayed explosion.

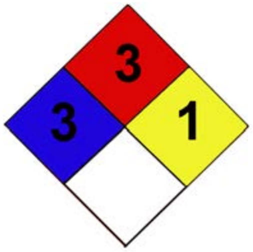
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin and eye contact with liquid allyl alcohol, repeated or prolonged skin contact with allyl alcohol vapor and any reasonable probability of eye contact with the liquid. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. A maker of allyl alcohol reports that neoprene may be compatible.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style, front or back mounted organic vapor canister or a chemical cartridge respirator with a full facepiece, within the use limitations of these devices.

1098

ALLYL ALCOHOL
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, skin, or respiratory system; symptoms of alcohol intoxication.

First Aid For Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Watch for signs of deepening depression and increased difficulty in breathing. Symptoms may be delayed with pulmonary edema developing some time after exposure.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with water for at least. 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing. In severe exposures, observe for signs of systemic intoxication as allyl alcohol is readily absorbed through intact skin.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting not be induced if immediate medical attention is available). Observe for signs of progressive intoxication. Symptoms such as loss of consciousness, deepening depression, or coma may develop some time after exposure has occurred. Systemic effects particularly target kidney and liver functions.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective but may be used to dilute spill to non-flammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with allyl alcohol. Wear self contained breathing apparatus and appropriate personal protective clothing. Move intact container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. Avoid taking positions along container ends. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water may be used to dilute allyl alcohol pools to non-flammable concentrations.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment where possible that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take into account when planning the response that allyl alcohol is a toxic and flammable liquid.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Allyl alcohol spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

ALLYL ALCOHOL
Division 6.1 (Poisonous Material)

AIR SPILL *(CONTINUED)*

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to allyl alcohol vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of allyl alcohol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of allyl alcohol vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid allyl alcohol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Allyl alcohol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained allyl alcohol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ALLYL ALCOHOL
Division 6.1 (Poisonous Material)

LAND SPILL *(CONTINUED)*

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substance.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gasses present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ALLYL ALCOHOL
Division 6.1 (Poisonous Material)

WATER SPILL *(CONTINUED)*

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ALLYLAMINE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Allylamine is a colorless to light yellow poisonous liquid with a strong irritating odor resembling ammonia. It is used in making pharmaceuticals and other chemicals and in improving the process by which textiles are dyed. The product is completely soluble in water and will mix freely and rapidly. Its flash point of -20°F indicates that it may be easily ignited under virtually all ambient temperature conditions. Vapors may be heavier than air at first and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.3 pounds per gallon.

Allylamine is stable in transportation, may attack cork and some types of rubber, and is best handled in equipment constructed of stainless or carbon steel. It is incompatible with acids and oxidizing agents that may cause its ignition. Toxicity of the product is high by all routes of exposure, including absorptions through the skin, and direct contact may result in severe irritation or burns of bodily tissues. Products of combustion include toxic oxides of nitrogen, carbon monoxide, and other toxic constituents.

If allylamine is leaking (not on fire), downwind evacuation of the spill area should be considered until properly equipped responders have evaluated the hazard. If a fire becomes uncontrollable or a bulk container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol, ether, and chloroform.
Specific Gravity (Liquid): 0.76 at 68°F (20°C)
Boiling Point: 131 – 136.4°F (55 - 58°C) at 1 atm.
Melting Point: Unavailable
Freezing Point: Unavailable
Molecular Weight: 57.1
Heat of Combustion: Unavailable
Vapor Pressure: 193 mm Hg (3.731 psia) at 68°F (20°C)

Flash Point: -20°F (-28.9°C), closed cup
Autoignition Temperature: 705°F (374°C)
Burning Rate: Unavailable
Stability: Stable
Corrosiveness: Attacks cork and some types of rubber. Zinc, galvanized steel, copper and copper alloys not satisfactory. Use stainless steel or carbon steel.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Incompatible with acids and oxidizing agents.

IDENTIFICATION

Shipping Names: Allylamine (USDOT and IMO)
Synonyms and Tradenames: 2-Propen-1-amine; 3-aminopropene; 3-aminopropylene; 2-propenylamine; 2-propenamine; monoallylamine
Chemical Formula: $CH_2CHCH_2NH_2$
Constituent Components (%each): Marketed in chemically pure and technical grades; expected to be relatively pure with some amount of water.

UN/NA Designation: UN2334
IMO Designation: 6.1, Poisonous substances
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to light yellow
Odor Characteristics: Like ammonia; strong; irritating
Common Uses: Making of pharmaceuticals and other chemicals; improving textile dyeing.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ALLYLAMINE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Recognizable at 2.5 ppm

Unusual Hazards: Volatile, highly flammable, and highly toxic liquid.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and downwind. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid allylamine may result in sever irritation or burns and the substance may be rapidly absorbed through the skin in toxic amounts. Contact with the eyes may cause severe irritation, burns, and possibly permanent eye damage.

Hazards of Inhalation: Vapors allylamine are extremely irritating to the eyes, nose, mouth, respiratory tract, and lungs and are intolerable to humans at a concentration of 14 ppm in air. Excessive or extended exposures may result in irregular respiration, cyanosis, excitement, convulsions, chemical pneumonia, possible liver and kidney injury, possible inflammation of the wall muscle of the heart, and death. Some effects may be delayed in onset. Note that exposure to 286 ppm in air for four hours was sufficient to kill 50% of rats in laboratory experiments.

Hazards of Ingestion: Allylamine is highly toxic if ingested. Although specific details are unavailable, irritation or burns of the mouth, throat, and stomach may be expected, as well as various symptoms of inhalation. It may be possible that aspiration into the lungs during vomiting may cause delayed pulmonary edema and chemical pneumonia with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit (LFL): 2.2%

Upper Flammable Limit (UFL): 22%

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable gas or vapor upon release.

Hazardous Combustion Products: Not well-defined; may include toxic oxides of nitrogen, carbon monoxide, and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

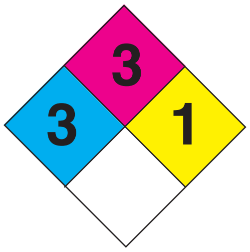
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with allylamine. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene according to one authority and butyl rubber according to another.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing appratus (SCBA) with full facepiece (or the equivalent).

2334

ALLYLAMINE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective but may be used to dilute spill to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the volatile, flammable, and toxic nature of allylamine into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION...Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Allylamine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport, and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY...Water fog or spray applied to allylamine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of allylamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ALLYLAMINE
Division 6.1 (Poisonous Material)

TECHNIQUE

DILUTION…The addition of a relatively large amount of water to liquid allylamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-house runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM...There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of allylamine vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Allylamine may be contained by building dikes using soil, sand, or other materials.

CONSEQUENCE

Contained allylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line connection area with compatible impervious materials.

TECHNIQUE

EXCAVATION...A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION...Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

ALLYLAMINE

Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION...Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION...Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL...Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice when necessary.

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES...Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ALLYLAMINE

Division 6.1 (Poisonous Material)

TECHNIQUE

ADSORPTION...Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION...Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION...Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July 1994

ALLYL BROMIDE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Allyl bromide is a clear, colorless to light yellow liquid with a pungent, irritating odor. It will cause tearing in the eyes and, with a flash point of -1°C, (30.2°F) is flammable under most circumstances. It is easily ignited by flame, sparks, or static discharges. The vapors are denser than air and will travel considerable distances to a source of ignition. Allyl bromide is practically insoluble in water and is heavier than water. As a result, when mixed with water, allyl bromide will tend to sink to the bottom of the mixture. Aside from its flammability, allyl bromide is fairly stable and not prone to hazardous polymerization reactions. On heating, it may decompose, producing toxic hydrogen bromide gas. It is toxic by ingestion, inhalation, and absorption. On direct contact, allyl bromide will produce strong irritation or burns to the skin, eyes or other mucous membranes. If vapors are inhaled, allyl bromide will cause irritation to the respiratory tract.

Allyl bromide is used in the manufacture of a variety of materials including intermediates for perfume manufacture and the manufacture of industrial resins.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble.
Solubility in Other Chemicals: Completely soluble in: alcohol, ether, chloroform, carbon disulfide, carbon tetrachloride.
Specific Gravity (Liquid): 1.39 - 1.43
Vapor Density (Air=1): 4.2
Boiling Point: 71.3°C (160.34°F)
Melting Point: *- 119.4°C (- 182.92°F)*
Freezing Point: - 119.4°C (- 182.92°F)
Molecular Weight: 120.99
Heat of Combustion: - 3700 cal/gm
Vapor Pressure: 133.92 mmHg @ 21.1°C (70°F)
Flash Point: - 1°C (30.2°F)
Autoignition Temperature: 295°C (563°F)
Burning Rate: 3.5 mm/min
Stability: Normally stable, may decompose on heating to produce hydrogen bromide gas.
Corrosiveness: Corrosive to tissues.
Reactivity with Water: May produce some heating in contact with water.
Reactivity with Other Chemicals: Incompatible with strong oxidizers. May react violently.

IDENTIFICATION

Shipping Names: Allyl bromide.
Synonyms and Tradenames: 3-bromopropene; bromoallylene; 3-bromo-l-propene; 3-bromopropylene; bromallyene; CAS 106-95-6.
Chemical Formula: $H_2C{:}CHCH_2BR$
Constituent Components (% each): 90 - 100% allyl bromide.
UN/NA Designation: UN1099
IMO Designation: 3.2, flammable material.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Colorless to light yellow liquid.
Odor Characteristics: Irritating, unpleasant, pungent odor.
Common Uses: Organic synthesis, preparation of resins, preparation of perfume intermediates.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ALLYL BROMIDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Allyl bromide is a highly flammable liquid. It is a strong irritant to skin and mucous membranes and is toxic by all routes of exposure. When ignited or exposed to heating, the combustion and decomposition products include toxic hydrogen bromide gas. Above the flashpoint, allyl bromide is explosive within the limits of flammability.

Short Term Exposure Limits (STEL): None determined.

Time Weighted Average (TLV-TWA): None determined.

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Allyl bromide is toxic and irritating by all routes of exposure. It is a strong irritant to skin and eyes and may produce severe burns to exposed tissues. The primary health risks are from direct contact with liquids or strong vapor concentrations in the vicinity of the spill.

Hazards of Skin and Eye Contact: Allyl *l* bromide will cause strong irritation or burns to the skin and the eyes. Contact lenses may be damaged by exposure to allyl bromide. This could contribute to additional eye injury. *Allyl* bromide can also be absorbed through intact skin which will contribute to systemic poisoning reactions.

Hazards of Inhalation: Allyl bromide is a strong irritant to the mucous membranes of the respiratory tract. Inhalation exposures can result in severe damage to tissues of the respiratory system. Given sufficient exposure, allyl bromide can be absorbed through the respiratory system to produce systemic poisoning.

Hazards of Ingestion: Allyl bromide is toxic by ingestion. It will produce severe burns to tissues of the mouth, throat, esophagus, and other tissues.

FIRE HAZARDS

Lower Flammable Limit: 4.4%

Upper Flammable Limit: 7.3 %

Behavior in Fire: Extremely flammable. Maybe ignited by static electrical discharges from transfer equipment or sparks from tools. Allyl bromide will produce flammable vapors on release. Heat will intensify vapor generation. Vapors are denser than air and may travel a considerable distance to ignition source and flash back. Contact with strong oxidizers may produce fire. Sealed containers exposed to heating, may rupture.

Hazardous Combustion Products: Products include highly toxic hydrogen bromide gas as well as carbon monoxide and carbon dioxide gasses. Decomposes when heated, releasing hydrogen bromide gas.

EXPLOSION HAZARDS

Explosiveness: May rupture container on heating. Generally stable except at elevated temperatures where it tends to decompose if not ignited. Sparks or static discharges from transfer equipment can ignite allyl bromide.

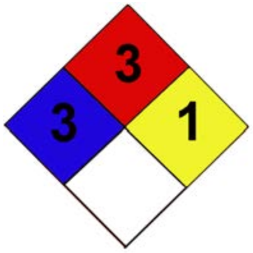
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with allyl bromide liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully encapsulating suits made of compatible material are appropriate for most large spill situations.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

1099

ALLYL BROMIDE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or burns to skin, eyes, or mucous membranes depending on point of contact. Symptoms may include dizziness and headache. Inhalation exposures may result in coughing, wheezing, laryngitis, shortness of breath, nausea and vomiting. Severe inhalation exposures may present respiratory spasms, laryngeal, bronchial and pulmonary edema, and chemical pneumonia. Edema of the respiratory tract may result in spasmodic breathing with loss of consciousness progressing to death by suffocation.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse, following acute exposure, resulting in increased respiratory distress with time. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance immediately.

First Aid for Ingestion: If victim is conscious, give water or milk and induce vomiting. Never give anything by mouth to, or induce vomiting in an unconscious person. Seek medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, compatible mufti-purpose foam, carbon dioxide, or dry chemical extinguishing agents. Water may not be effective except when applied as a blanket.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with allyl bromide. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water may be effective if applied in a manner which entirely covers the surface of a spilled liquid (a blanket). In forming a blanket, water should be applied in a gentle manner which does mix or disperse the allyl bromide pool. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam is appropriate for fires involving allyl bromide.

SPILL RESPONSES

General Information: Allyl bromide is highly flammable and easily ignited. Response strategies should account for the fact that flammable vapors are heavier than air and may travel some distance to a source of ignition. Intact containers containing allyl bromide may rupture violently if exposed to extreme heat or fire. When spilled in water, allyl bromide is only slightly soluble and will tend to settle to the bottom of the water column depending on velocity of water flow. All spill responses should consider that until the product is removed to safe containers, ignition is possible. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of allyl bromide may result in explosion. Use only spark proof tools when working around allyl bromide. Be sure lighting systems are of explosion proof design (intrinsically safe). Be alert to sources of ignition and static electrical discharge. Ground all transfer equipment to prevent static charge buildup.

ALLYL BROMIDE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Allyl bromide spills may expose downwind areas to toxic or flammable concentrations over considerable distances, in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment is available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY**. . .** Water fog applied to allyl bromide vapors or fumes may accelerate their dispersal in the atmosphere. This technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain a small amount (if any) of allyl bromide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of allyl bromide vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with allyl bromide.

TECHNIQUE

WATER APPLICATION . . . Application of water to the surface of liquid allyl bromide pools may reduce the emission of vapors or fumes. Water, if applied carefully (as a blanket), without disturbing the spilled liquid pool, will float on the spill surface slowing the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will add to the spill volume.

MITIGATION

Contain increased volume and remove spill as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of allyl bromide on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

ALLYL BROMIDE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Allyl bromide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination. Collected allyl bromide will still pose a significant fire risk.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material. Take steps to protect pooled liquids from ignition sources.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking product.

CONSEQUENCE

Allyl bromide may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Allyl bromide is highly flammable and explosion proof (intrinsically safe) equipment must be used.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION . . . Spilled liquids can be absorbed and immobilized with inert materials such as sand, earth, saw dust, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with allyl bromide and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by-removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with allyl bromide may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines. Explosion proof (intrinsically safe) equipment must be used due to the high flammability of allyl bromide.

ALLYL BROMIDE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Removed materials may pose a continued risk of fire or contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

CONTAINMENT . . . Spilled allyl bromide is denser than water and will tend to sink to the bottom, depending on the velocity of the water body. Use natural deep water pockets, excavated lagoons, or barriers to trap material on the bottom and limit spread of contamination.

CONSEQUENCE

Material will likely continue to migrate downstream despite containment measures. Excavations are difficult and are not 100% effective.

MITIGATION

Monitor downstream users and test for signs of contamination. Excavate as a last resort. Take steps to remove trapped pockets of ally1 bromide as soon as possible.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic or flammable vapors.

MITIGATION

Consult qualified experts. Decontaminate equipment after use. Arrange to store and dispose of recovered materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

January 1989

ALLYL CHLORIDE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Allyl chloride is a colorless or straw-colored to brownish liquid with a sharp, irritating, and somewhat garlic like odor. It is used for making other chemicals, pharmaceuticals, insecticides, and a variety of other products. Allyl chloride is slightly soluble in water and slightly lighter, so it will generally float on water and slowly dissolve. The product produces hydrogen chloride upon storage and may also undergo slow hydrolysis in water to form allyl alcohol and hydrochloric acid. Its flash point of –25°F indicates that allyl chloride can easily be ignited under virtually all ambient temperature conditions. Its normal boiling point of 113°F indicates that it may boil at high ambient temperatures or otherwise evaporate rapidly producing large amounts of vapor. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited and containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weights approximately 7.8 pounds per gallon.

Allyl chloride does not react with many common materials but is mildly to moderately corrosive to several metals, rubbers, and plastics. Although it is relatively stable in normal transportation, elevated temperatures as in fire conditions can cause self-polymerization in a reaction that may cause violent container rupture. Violent or explosive reactions can also occur in contact with acids, caustics, certain metallic chlorides, and a variety of other chemicals. Toxicity by all routes, including skin absorption, is high. Products of combustion may include toxic hydrogen chloride gas, phosgene, carbon monoxide and other substances that may cause lung damage.

Downwind evacuation should be considered if allyl chloride is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the containers should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.36% by weight at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and ligroin.
Specific Gravity (Liquid): 0.938 at 68°F (20°C)
Boiling Point: 113°F (45°C) at 1 atm.
Melting Point: –210.1°F (–134.5°C)
Freezing Point: –210.1°F (–134.5°C)
Molecular Weight: 76.53
Heat of Combustion: –5416 cal/g
Vapor Pressure: 294.3 mm Hg (5.69 psia) at 68°F (20°C)
Flash Point: –25°F (–31.7°C), closed cup; –20°F (–28.9°C), open cup.
Autoignition Temperature: min. 737°F (391°C); max. 905°F (485°C); reported values vary.
Burning Rate: Unavailable
Stability: Relatively stable in normal transportation. May polymerize under conditions described above.
Corrosiveness: Corrodes carbon steel appreciably in presence of water. Will attack some forms of plastics, rubber, and coatings. Avoid contact with galvanized steel.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with acids, caustics, amines, ammonia, active metals, metal alkyls, metal halides, strong oxidizers, peroxides, ethyleneimine, and benzene or toluene in presence of certain metal alkyls or halides.

IDENTIFICATION

Shipping Names: Allyl chloride (USDOT and IMO)
Synonyms and Tradenames: 3-Chloropropene; chlorallylene; 1-chloro-2-propene; 3-chloropropylene; 1-chloroproprene-2; 3-chloropropene-1; alpha-chloropropylene; 2-propenyl chloride; 3-chloro-1-propene.
Chemical Formula: CH_2CHCH_2Cl
Constituent Components each): 97% min. purity
49 STCC: 49 074 12
UN/NNA Designation: UN1100
IMO Designation: 3.1, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to straw or dark brown; purple on occasion.
Odor Characteristics: Sharp, penetrating; irritating; pungent and unpleasant; garlic like.
Common Uses: Mfg. of resins, **pharmaceuticals,** insecticides, glycerine, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ALLYL CHLORIDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

***Threshold Odor* Concentration:** 0.2–3 ppmppm

Unusual Hazards: Highly volatile, flammable, and toxic liquid with heavier than air vapors that may persist in low areas. Heat or chemical contaminants may promote violent self-polymerization.

Short Term Exposure Limits (STEL): 2 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 1 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Contact with heat, ignition sources and incompatible materials; runoff to sewers or water; all exposures to vapor or liquid.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation or possibly high vapor concentrations in air. Other hazards include skin contact and ingestion.

Hazards of Skin or Eye Contact: Skin contact may cause painful irritation, blistering, and deep-seated pain that becomes apparent several hours later. The liquid can be absorbed through the skin in toxic amounts. Eye contact may produce painful irritation and transient injury.

Hazards of Inhalation: Breathing vapors may cause irritation of the upper respiratory tract. High concentrations in air may cause headache, dizziness, nausea, unconsciousness and possibly death. Lung injuries may appear several hours after exposure. Inhalation of only 49 ppm in air for 10 minutes is lethal to some mice. Rats can only survive up to 4 hours at 290 ppm.

Hazards of Ingestion: Ingestion may cause heart, liver, and kidney damage.

FIRE HAZARDS

Lower Flammable Limit: 3.3%

Upper Flammable Limit: 11.15%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distances to a source of ignition and flash back. Containers may rupture violently. Exposure to heat may result in violent polymerization.

Hazardous Combustion Products: *Toxic* hydrogen chloride, phosgene, carbon monoxide, and others that may cause lung damage.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Excessive heat may cause violent polymerization resulting in container rupture. Violent polymerization may also occur in presence of acids, metal chlorides, and other substances. Contact with some chemicals may result in formation of explosive mixtures.

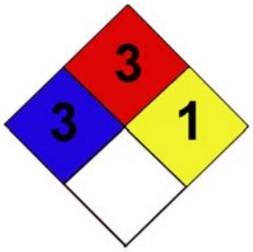
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or smoke concentrations in air. Compatible materials include polyvinyl alcohol and butyl rubber.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 1 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1100

ALLYL CHLORIDE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms:

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious and not very drowsy, administer two glasses of water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Water spray, alcohol foam, dry chemical, and carbon dioxide.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Avoid contact with spilled product. Keep unprotected personnel upwind of spill area. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of product may result in damage or explosion of boilers or industrial process equipment. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Use explosion-proof equipment where necessary. Choose equipment that is not corroded or otherwise damaged by the spilled product. Note that oil spill response equipment may only be effective in early stages of response. Floating allyl chloride will slowly dissolve in water. Take into account while planning the response that allyl chloride is a highly volatile, toxic, and flammable substance. It may polymerize violently under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Allyl chloride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ALLYL CHLORIDE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to allyl chloride vapors or fumes may accelerate their dispersal in the atmosphere. ,

CONSEQUENCE

Water runoff may contain a small amount (if any) of allyl chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools will slow the release of allyl chloride vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Allyl chloride may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained allyl chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, clay, fly ash, cement powder, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ALLYL CHLORIDE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

ALLYL CHLORIDE
Class 3 (Flammable Liquid)

TECHNIQUE '

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating allyl chloride.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with allyl chloride may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to condition: that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated body of water and subsequent mixing may neutralize any hydrochloric acid that has formed in water.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

GENERAL INFORMATION

Aluminum chloride solution, also commonly known as aluminum chloride hexahydrate, has a range of reported colors from colorless to yellow, gray or light green with a strong pungent odor like hydrogen chloride while others report it having no odor. It is used as a cleaning compound as well as an engine cooling system and in the manufacturing of rubber, dyes and pharmaceuticals. It is shipped as a liquid and is corrosive to a variety of materials and bodily tissues. It has a low pH, between 1-2 with most reporting a value of 1, and is therefore a strong acid. Its high boiling point and low evaporation rate indicate that in most spill situations, without fire, it may not pose a large airborne hazard. It is soluble in water and may evolve heat in the process. Flammable and potentially explosive hydrogen gas may be generated upon contact of the product with metals, such as zinc or magnesium, or highly acidic solutions. The solution weighs approximately 10.7 pounds per gallon.

Aluminum chloride is highly toxic and can cause skin irritation, severe eye irritation and possible injury as well as severe respiratory and digestive tract irritation with possible burns.

Aluminum chloride solution is stable in normal transportation and hazardous polymerization will not occur. It is reactive with a variety of chemicals and forms hydrochloric acid with water, which is corrosive. It may fume in air due to hydrogen chloride formation.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Complete
Solubility in Other Chemicals: Soluble in alcohol, ether, glycerol, propylene glycol, benzene, methanol, and chloroform; slightly soluble in hydrochloric acid.
Specific Gravity: 1.27
Vapor Density: Unavailable
Boiling Point: 230ºF (110ºC)
Melting Point: Unavailable
Freezing Point: -31ºF (-35ºC)
Molecular Weight: 241.43
Heat of Combustion: Not flammable
Evaporation Rate (butyl acetate=1): Negligible
Vapor Pressure: Approximately 17.5 - 20 mmHg
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable Limits: Not flammable
Stability: Stable
Polymerization Potential: Will not occur.
pH: 1.0 - 2.0
Corrosiveness: Corrosive to metal and tissues.
Reactivity with Water: May react.
Reactivity and Incompatibility: Do not store in the presence of reactive metals, e.g. zinc or magnesium, or highly acidic solutions as hydrogen may be evolved which when mixed in air may result in fire or explosion if ignited. Considerable heat will be evolved if aluminum chloride solution comes in contact with strong bases. Avoid strong acids, nitrobenzene, alkenes, a mixture of benzoyl chloride and naphthalene, a mixture of aniline and ethyleneimine, ethylene oxide, a mixture of sodium peroxide and aluminum, oxygen difluoride, phenyl azide, perchloryl benzene, sodium borohydride, or water. Reacts with caustic, evolving heat and precipitating aluminum hydroxide.

IDENTIFICATION

Shipping Name(s): Aluminum chloride, solution (USDOT & IMO).
Synonyms and Tradenames: Aluminum chloride hexahydrate; Aluminum(III) chloride hexahydrate; Aluminum Trichloridehexahydrate; Trichloroabluminum hexahydrate; Aluminum trichloride; Trichloroaluminum.
CAS Registry No.: 7446-70-0 (anhydrous) 7784-13-6 (liquid)
Chemical Formula: $AlCl_3 \cdot 6H_2O$
Constituent Components (% each): Percentage of aluminum chloride in solution varies widely.
UN/NA Designation: UN2581
IMO Designation: 8, Corrosives
RTECS Number: BDO525000
NFPA 704 Hazard Rating: 3(Health): 0(Flammability): 2(Reactivity); Reacts with water.
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Reports vary. Clear liquid, may be water white to gray to light amber green in color.
Odor Characteristics: Pungent like hydrogen chloride, some sources report it having no odor.
Reportable Quantity: See appendix I.
Common Uses: It is reported to be used as a cleaning compound as well as an engine cooling system and in the manufacturing of rubber, dyes and pharmaceuticals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Reaction with some metals and acids evolves hydrogen gas which is corrosive.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 10 mg/m^3 (ACGIH); 15 mg/m^3 (OSHA PEL)

Ceiling (C) Limit: Unavailable

IDLH: Not determined

Conditions to Avoid: Contact with incompatible materials; fire or sparks where hydrogen may be present; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact of the skin with aluminum chloride solutions may cause skin irritation, and with greater exposure, severe burns with scarring. Similarly, contact with the eyes may result in irritation, severe burns, and possible blindness.

Hazards of Inhalation: Breathing of aluminum chloride mist may cause irritation and burns to the nose, throat, and respiratory tract.

Hazards of Ingestion: Ingestion this material may be harmful or fatal. Symptoms may include severe stomach and intestinal irritation (nausea, vomiting, diarrhea), abdominal pain, and vomiting of blood. This material may cause burns and destroy tissue in the mouth, throat, and digestive tract.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Some remote chance that containers may rupture in fire.

Hazardous Combustion Products: Decomposition by reaction with certain metals or strong acids may release flammable and explosive hydrogen gas. Fire or excessive heat may decompose material to hydrochloric acid.

EXPLOSION HAZARDS

Explosive Limit: Not flammable

Explosive Potential: Contact with metals or strong acids may generate hydrogen gas that may explode if ignited in confined spaces. Some remote chance that containers may rupture in fire.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing for liquids (as appropriate). One manufacturer recommends the use of Polytyvek as compatable clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with mist concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations a self-contained breathing apparatus (SCBA) with full facepiece. An air purifying respirator (APR) with an organic vapor cartridge or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels of their use. Protection by air purifying respirators is limited.

2581

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Reports vary on whether to administer water, milk or nothing as well as whether to induce vomiting; seek medical advice in this instance. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear self-contained breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources where hydrogen may be present. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that contact of material with some metals and acids may generate hydrogen gas. Use intrinsically safe equipment where necessary.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists. (Note: Solutions do not pose a problem unless an airborne mist is somehow generated. In the event a mist is generated, follow guidelines for water fog or spray below.)

CONSEQUENCE

Hazardous levels of aluminum chloride in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations toxic vapors.

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to aluminum chloride vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Note: Aluminum chloride has the potential to react with water, and should be used with caution and downwind from source of spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of aluminum chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may seep through dike material, which may result in loss of confined product and spread of contamination. There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. (Note: Aluminum chloride has the potential to react with water, and should be used with caution and downwind from source of spill.) Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination if some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. (Note: Aluminum chloride has the potential to react with water, and should be used with caution and downwind from source of spill.) Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled liquid pools confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid aluminum chloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ALUMINUM CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

ALUMINUM SULFATE

Class 8 (Corrosive Material) or Class 9 (Miscellaneous Hazardous Material)

GENERAL INFORMATION

Aluminum sulfate may be shipped as lustrous white to grayish white crystals, granules, pieces or powders, or as liquid solutions in water that are variably described as colorless, clear light green, or amber in appearance. The product is odorless and not flammable. Solid forms are soluble in water and heavier, as are solutions. Numerous uses of aluminum sulfate include the making of aluminum compounds, antiperspirants, paper, pesticides, pigments, rayon, firefighting foams, and other products. It is also used to clarify fats, oils, and petroleum products; waterproof concrete and cloth; fireproof cloth; tan leather, dye textiles; and clarify and or purify sewage and water.

Solid aluminum sulfate dissolves in water while generating a limited amount of heat and then hydrolyzes to form some amounts of sulfuric acid. The product is simply reported as incompatible with strong bases and water-reactive materials (such as oleum) and apparently has the potential to react violently with some such materials. The solid is an irritant to bodily tissues, particularly in the presence of moisture, solutions are acidic and also irritating and potentially corrosive to such tissue. The solid may corrode metals, particularly iron and aluminum in the presence of moisture. Solutions contain sulfuric acid and may be corrosive to several metals while producing potentially flammable and explosive hydrogen gas. Products of thermal decomposition resulting from exposure of aluminum sulfate to very high temperatures include highly hazardous gases such as sulfur dioxide and sulfur trioxide.

There are several forms of aluminum sulfate of interest. The pure substance is anhydrous (i.e., does not contain any water), is hygroscopic, and will therefore gradually absorb water upon exposure to air. Also found in commerce are two hydrates of the substance known as the "tetradecahydrate" and the "octadecahydrate". The tetradecahydrate is best described as a molecule of anhydrous aluminum sulfate that has chemically attached to 14 molecules of water. Similarly, a molecule of the octadecahydrate is a molecule of the anhydrous product combined with 18 molecules of water. Solutions discussed in this guide may contain various amounts of these solids dissolved in water.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; but reported values vary. Most consistent data appear to include 36.4 g/100 g water at 68°F (20°C) for anhydrous solid; about 50 g/100 g for solid tetradecahydrate at unspecified temperature; 87 g/100 g water at 32°F (0°C) for solid octadecahydrate; solutions are soluble in all proportions. Solubilities of the solids generally increase with temperature.

Solubility in Other Chemicals: The anhydrous solid is reported as soluble in dilute acid.

Specific Gravity: Approx 2.7 at 68°F (20°C) for the anhydrous solid; about 1.6-1.7 for solid hydrates; about 1.34 at the above temperature for an apparently typical but otherwise unspecified solution.

Boiling Point: 214°F (101°C) at 1 atmosphere for a 45% solution of the tetradecahydrate in water; upon long boiling, an insoluble basic salt precipitates out of solutions according to one authority.

Melting Point: The anhydrous product decomposes at a high temperature variably reported as 1200°F (650°C) or 1400°F (770°C); the solid octadecahydrate melts and decomposes at about 188°F (86.6°C); data are unavailable for the other solid hydrate; apparently typical but otherwise unspecified hydrate solutions melt at temperatures on the order of 3.2°F (–16°C).

Freezing Point: See melting point

Molecular Weight: 342.1 for anhydrous solid; 594 for solid tetradecahydrate; 666.4 for solid octadecahydrate

Heat of Combustion: Not flammable

Vapor Pressure: Specific data unavailable; apparently very low or negligible for the solids and their solutions

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable with respect to any sort of hazardous activity in normal transportation. On exposure to air, the anhydrous product will gradually absorb moisture from the atmosphere. Hydrates of aluminum sulfate may lose some amounts of moisture when exposed to heat.

Corrosiveness: Solid aluminum sulfate may corrode metals in the presence of moisture according to several authorities, iron and aluminum are specifically mentioned as vulnerable. Solutions contain sulfuric acid, may be corrosive to several metals, and may generate hydrogen gas during the corrosion process.

Reactivity with Water: The solid dissolves in water with evolution of some heat and readily hydrolyzes to form some amounts of corrosive sulfuric acid. Some authorities therefore consider the product reactive with water; others do not.

Reactivity with Other Chemicals: Very little information is available; one data source reports the substance may react violently with strong bases; another lists alkalies (i.e., bases) and water reactive materials such as oleum as incompatible materials.

IDENTIFICATION

Shipping Names: Corrosive liquid, n.o.s. (USDOT and IMO for solutions); Enviromentally hazardous substance, solid, n.o.s. (USDOT and IMO for solid).

Synonyms and Tradenames: Aluminum alum; aluminum sulfate (2:3); aluminum trisulfate; dialuminum sulfate; dialuminum trisulfate; filter alum; paper maker's alum; pearl alum; pickle alum; sulfuric acid, aluminum salt; sulfuric acid, aluminum salt (3:2).

Chemical Formula: $Al_2(S0_4)_3$ for anhydrous solid; $Al_2(S0_4)_3.14H_20$ for the tetradecahydrate; $Al_2(S0_4)_3.18H_20$ for the octadecahydrate.

Constituent Components (% each): Several grades of the solid are commercially available, including the anhydrous product; some may be 98% or more pure. As best as can be determined, solutions typically contain 33 to 50% by weight of one of the solid forms (i.e., the anhydrous product or its hydrates).

UN/NA Designation: UN1760 (USDOT and IMO for solutions) UN3077 (USDOT and IMO for solids)

IMO Designation: 8, corrosive; 9, miscellaneous, dangerous substance

Physical State As Shipped: Solid crystals, pieces, granules or powder, liquid solution of solid in water

Physical State As Released: Same as shipped

Color of the Shipped Material:Solid is variously described as white and lustrous or grayish white; solutions are variably described as colorless or appearing as a clear light green or amber liquid.

Odor Characteristics: Odorless

Common Uses: Making aluminum compounds and resinate antiperspirants, agricultural pesticides, pigments, viscose rayon, and ingredients of firefighting foams; leather tanning; dyeing mordant; deodorizing and decoloring petroleum products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ALUMINUM SULFATE
Class 8 (Corrosive Material) or Class 9 (Miscellaneous Hazardous Material)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: An aluminum sulfate concentration as low as 5 ppm in water may cause an increase in the lead content of the drinking water where lead pipes are used for distribution. Forms corrosive sulfuric acid when dissolved in water.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: 2 mg/m^3 as aluminum (Al), for soluble salts of aluminum, over each 8 hours of a 40 hour work week (ACGIH TLV, 1990-91; OSHA PEL, 1989).

Conditions to Avoid: Generation of airborne dusts or mists; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion or direct physical contact; wetting of the dry product; exposure of the product to very high temperatures.

HEALTH HAZARDS

Public Health Hazards: The primary hazard of the product is the irritation and potential burns it may cause to bodily tissues upon direct contact in the presence of moisture.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with aluminum sulfate solutions may result in skin irritation, as may contact with the solid and its dusts, particularly if moisture is present. Open cuts are especially vulnerable. Repeated or prolonged skin contact (presumably of the hands) has been reported to cause numbness in the fingers. Contact of the eyes with aluminum sulfate dust may cause significant irritation, inflammation, and possibly burns; contact with concentrated liquid solutions or mists may possibly result in severe eye damage. One maker of the product generally observes that contact lenses should not be worn when working with chemicals because they may potentially contribute to the severity of an eye injury. It is not clear whether this precaution is specifically required for aluminum sulfate.

Hazards of Inhalation: Fine airborne dusts or mists of solid aluminum sulfate may irritate the eyes, nose, mouth, throat, and bronchial tubes of the lungs. Symptoms may include sore throat, tightness and pain in the chest, and coughing. High concentrations in air may cause congestion and constriction of the airways leading to difficult breathing in short-term exposures. Prolonged inhalation of 2 - 4 mg/m^3 of aluminum sulfate in air has been reported to cause scarring of upper lung tissue.

Hazards of Ingestion: Aluminum sulfate is of comparatively low oral toxicity. Nevertheless, ingestion of significant amounts of the solid product may result in irritation of the gastrointestinal tract, abdominal pain, nausea, and vomiting. Concentrated solutions (over 20%) can cause burns of the mouth and digestive tract, a bleeding stomach, incoordination, muscle spasms, and kidney injury. Since the solid will dissolve in moisture, some of these latter effects may also follow ingestion of the solid. Repeated ingestion of the product may result in a phosphate deficiency that can weaken bones. The LD_{50} for mice, the single dose expected to kill 50% of the animals, is in the range of 6.1 to 10.8 g/kg of body weight according to various authorities; that for the rat is listed as 1.93 g/kg by one source. A maker of the product provides an estimated human fatal dose of 30 grams, presumably for adults.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Not flammable. Although not reported elsewhere, there appears to be a possibility that exposure of well-sealed containers of aluminum sulfate solutions to excessive and prolonged heat may possibly cause generation of sufficient steam pressure to cause rupture of the containers. The rupture may possibly take place with violence if the container is of strong construction (such as a metal tank). There is a possibility that hydrated solids may also evolve water vapor or steam under such conditions. Very high temperatures will cause decomposition of the solid product.

Hazardous Combustion Products: At very high temperatures, variably reported as above 1200°F (650°C) or 1400°F (760°C), aluminum sulfate is said to generate toxic gases such as sulfur dioxide and/or sulfur trioxide. These gases are also oxidizers and corrosives; the trioxide is a fire hazard. Evolution of these gases leaves a caustic residue

1760

ALUMINUM SULFATE

Class 8 (Corrosive Material) or
Class 9 (Miscellaneous Hazardous Material)

See UN/NA Designation for
other ID numbers.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: See Behavior in Fire section directly above for a discussion of container rupture potential. Note that contact of some metals with corrosive solutions may result in the generation of potentially flammable and explosive hydrogen gas.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of eye contact and any reasonable probability of skin contact with the spilled product. This may include rubber boots, gloves, face shields, tight-fitting dust or splash-proof safety goggles as needed, and other appropriate protective clothing such as coveralls, aprons, long-sleeved shirts, and so forth. An acid resistant slicker suit is recommended by a maker of the product for response to liquid spill situations.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations of dusts or mists in air, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For other working conditions, a NIOSH-approved dust or mist respirator appropriate for the airborne contaminant levels present and used within the limitations of the device as determined by a suitably qualified individual.

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Rinse nose and mouth with water in the event of dust exposure. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim’s lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Authorities disagree over the proper course of treatment. The majority suggest that one or two glasses of water be administered immediately if the victim is conscious and that vomiting NOT be induced. It appears this decision is based on the generally low oral toxicity of aluminum sulfate and the conclusion that potential irritation or burns of the gastrointestinal tract are less hazardous than the risk associated with aspiration of possibly corrosive fluids into the lungs if vomiting is induced. It is probably best that the decision of whether or not to induce vomiting be made by a physician if one is readily available. In any case, if vomiting occurs naturally or otherwise, have the victim lean forward to reduce the risk of aspiration into the lungs and then repeat administration of water. Never attempt to make an unconscious person vomit. Get medical attention immediately.

ALUMINUM SULFATE

Class 8 (Corrosive Material) or Class 9 (Miscellaneous Hazardous Material)

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but be advised that some authorities recommend against use of water or foam on fires involving solid aluminum sulfate, where possible, since corrosive liquids containing sulfuric acid may be produced. Consequently, it appears prudent to use carbon dioxide or dry chemicals where supplies are adequate to safely extinguish the fire. Water and foam are best used for large fires or fires involving aluminum sulfate solutions. Note that solid aluminum sulfate and its solutions in water are not combustible or flammable.

Extinguishing Techniques: Stay upwind. Avoid bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use professional judgment to decide if sealed metal drums or other containers or tanks exposed to excessive heat or fire should be kept cool via use of water sprays to avoid the possibility of container rupture due to buildup and pressurization of gases or steam in the container. If deemed necessary, use water from side and from safe distance to keep containers cool until well after fire is out. For a massive fire in the cargo area under these circumstances, it may be prudent to use unmanned hose holders or monitor nozzles. In any case, stay away from the ends of tanks involved in fire, especially of solutions, but realize shrapnel may travel in any direction. See earlier discussions about the hazardous decomposition products of aluminum sulfate and its hydrates at elevated temperatures and attempt to prevent such decomposition. Keep any exposed solid product dry if possible and practical.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers and water bodies. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or other hazard to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Keep the solid product dry if practical to avoid spread of contamination. The anhydrous product should be kept in tightly closed containers to avoid absorption of water from the atmosphere if practical. Take the potential corrosivity of aluminum sulfate and its hydrates and solutions into account while planning the response. Give special attention to the hazardous products of thermal decomposition that may evolve at high temperatures.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Aluminum sulfate and its solutions will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in most cases to simply monitor the situation until the spilled product is removed. (Note: In order to pose a significant downwind inhalation hazard, fairly large quantities of fine aluminum sulfate dusts or mists must somehow become airborne. Consider downwind evacuation or an alternative protective action where necessary if this should occur.)

CONSEQUENCE

Hazardous levels of aluminum sulfate may possibly be found in air in the local spill area and immediately downwind, particularly if the solid product has been discharged in a finely, powdered form.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill and areas immediately downwind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid aluminum sulfate with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

ALUMINUM SULFATE

Class 8 (Corrosive Material) or Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to aluminum sulfate dusts or mists in air may knock them down and accelerate their dispersal in the atmosphere. Apply water at a point downwind if solid aluminum sulfate is exposed to prevent dissolution in water, generation of sulfuric acid, and spreading of contamination.

CONSEQUENCE

Water runoff may contain sulfuric acid and other substances from contact with dusts or mists of aluminum sulfate.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Aluminum sulfate and its solutions may be contained by building dikes or barriers using soil, sand or other compatible materials. Note that even very low levels of the product in soil may adversely affect the growth of plants and crops and act accordingly. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Keep solid aluminum sulfate dry to the extent possible. Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product particularly solutions.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of solutions may be controlled by absorbing the liquid with sand earth, clay, vermiculite, perlite, fly ash, cement powder, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessarv, neutralize sorbents under guidance of a qualified expert. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

ALUMINUM SULFATE

Class 8 (Corrosive Material) or Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product or its residues may be removed by brooms. shovels. motorized graders, scrapers, loaders, bulldozers, or draglines as appropriate.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause aluminum sulfate dust to become airborne.

MITIGATION

Select removal procedures that do not cause aluminum sulfate dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid aluminum sulfate will sink in water and dissolve at a fairly rapid rate, particularly if water is plentiful compared to the amount of aluminum sulfate spilled. Solutions of the product will dissolve freely in water. Note that this substance is reported to be harmful to aquatic life in very low concentrations. It is also reported that the natural alkalinity of receiving waters may result in precipitation of aluminum hydroxide. $Al(OH)_3$, also known as alumina trihydrate and aluminum hydrate. which is insoluble in water. Neutralization agents such as sodium bicarbonate or lime are also reported to precipitate this substance out of solution.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained or diverted to impoundment area by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier- than-water solids that have not dissolved and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

September 2000

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas) or Division 2.3 (Poison Gas)

GENERAL INFORMATION

Anhydrous ammonia and ammonia solution (containing greater than 50% ammonia) are colorless and have the pungent characteristic odor of ammonia. Both anhydrous ammonia and ammonia solution are shipped in the liquid state, the gas shipped under pressure as a liquid. It is used as a refrigerant and in making fertilizers, explosives, synthetic fibers, plastics, pharmaceuticals, household cleaners, dyes, and a wide variety of other chemicals and products. It is quite soluble in water and dissolves to form an alkaline ammonium hydroxide solution with the evolution of heat. Although it is considered nonflammable under conditions likely to be encountered, it can be ignited with an appropriate ignition source within a relatively narrow range of concentrations in air. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The liquid product weighs approximately 5.7 pounds per gallon at its low boiling point of -28°F.

The major hazard of anhydrous ammonia spills is that the product will boil or vaporize rapidly upon release to form a substantial vapor cloud or plume that may expose downwind areas to toxic concentrations in air over considerable distances. Also to be noted is that the product is corrosive to aluminum, tin, copper, lead, silver, zinc and other alloys; forms highly explosive products with calcium hypochlorite bleaches, gold, mercury, and silver; is otherwise reactive with a variety of chemicals, and is corrosive to bodily tissues.

Downwind evacuation should be considered if anhydrous ammonia is leaking but not on fire. Although ammonia does not meet the DOT definition of a flammable gas (for labeling purposes), it should be treated as one.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 51 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, chloroform, and ether.
Specific Gravity (Liquid): 0.682 at -28.1°F (-33.4°C)
Vapor Density: .6
Boiling Point: -28.0°F (-33.35°C)
Melting Point: -107.9°F (-77.7°C)
Freezing Point: See melting point.
Molecular Weight: 17.03
Heat of Combustion: -4440 cal/g
Evaporation Rate (butyl acetate=1): Faster than water if in solution.
Vapor Pressure: 5 atm at 40.5°F (4.7°C); 10 atm at 78.3°F (25.7°C); 8,500 mmHg at 68°F (20°C)
Flash Point: Not flammable under conditions likely to be encountered.
Autoignition Temperature: 1204°F (651°C)
Burning Rate: 1 mm/minute
Flammable Limits: 15%(LEL) - 28%(UEL)
Stability: Stable
Polymerization Potential: Will not occur.
pH: Unavailable
Corrosiveness: Attacks aluminum, tin, copper, lead, silver, zinc, and other alloys; some forms of plastics, rubber, and coatings; gold and mercury.
Reactivity with Water: Dissolves with evolution of heat to form ammonium hydroxide. Action upon contact is vigorous and also evolves ammonia vapors.
Reactivity and Incompatibility: Reacts with acids, amides, organic anhydrides, isocyanates, vinyl acetate, alkylene oxides, epichlorohydrin, aldehydes, strong oxidizers, calcium hypochlorite bleaches, halogens, gold, silver, mercury, acrolein, and numerous other substances.

IDENTIFICATION

Shipping Name(s): Ammonia, anhydrous or Ammonia solution (USDOT & IMO)
Synonyms and Tradenames: Ammonia; Ammonia gas; Liquid ammonia; Nitro-sil; Spirit of hartshorn; Am-fol.
CAS Registry No.: 7664-41-7
Chemical Formula: NH_3
Constituent Components (% each): 99.5% or more pure
UN/NA Designation: UN1005(anhydrous) UN3318 (solution)
IMO Designation: 2.3, Toxic gases
RTECS Number: BO0875000
NFPA 704 Hazard Rating: 3(Health): 1(Flammability): 0(Reactivity)
Physical Form as Shipped: Compressed liquefied gas.
Physical Form as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Extremely pungent
Reportable Quantity: See appendix I.
Common Uses: Refrigerant; fertilizer; mfg. of explosives, fertilizers, synthetic fibers, explosives, plastics, pharmaceuticals, household cleaners, dyes, and other chemicals and products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas)
or Division 2.3 (Poison Gas)

or

or

* 1005 (Anhydrous) 3318 (Solution)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.037-20 ppm reported

Unusual Hazards: Highly volatile and toxic substance. Will boil or rapidly vaporize upon release producing large amounts of vapor.

Short Term Exposure Limit (STEL): 35 ppm (27 mg/m^3)

Time Weighted Average (TLV-TWA): 25 ppm (18 mg/m^3)

Ceiling (C) Limit: No data

IDLH: 300 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major public hazard is from inhalation of the high vapor concentrations in air that may occur in the local spill area and over considerable downwind distances. Contact with the liquid or highly concentrated vapors is also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of liquid ammonia with the skin may cause frost bite as well as first and second degree burns which are often severe and may be fatal if extensive. Vapors in air at 30,000 ppm or higher levels may cause a stinging sensation followed by skin burns and blisters. Contact of the liquid with the eyes may result in serious injury or blindness, as may prolonged contact with vapors in air above 700 ppm.

Hazards of Inhalation: Ammonia vapors may cause burning and tearing of the eyes, runny nose, coughing, chest pain, and irritation of the nose and throat. Severe exposures may result in difficult breathing, bronchospasm, bronchitis, pulmonary edema, pneumonia, and possibly death. Some of these effects may be delayed in onset and may be accompanied by pink frothy sputum. Note that 5000 ppm in air may be almost immediately fatal due to serious edema, strangulation, and asphyxia.

Hazards of Ingestion: Ammonia is not a systematic poison but is corrosive to the mouth, throat, and stomach.

FIRE HAZARDS

Lower Flammable Limit: 15%

Upper Flammable Limit: 28%

Behavior in Fire: Nonflammable compressed liquefied gas. Will burn but difficult to ignite. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of toxic gas or vapor upon release. Fire hazard increases in the presence of oil or other combustible materials.

Hazardous Decomposition Products: Not well-defined; may include nitrogen oxides, nitrogen gases and unburned ammonia. Hydrogen on heating over 850°F, if in the presence of certain metals such as nickel, temperature may be lowered to 575°F.

EXPLOSION HAZARDS

Explosive Limit: Not flammable

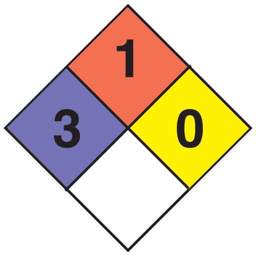
Explosive Potential: Containers may rupture violently in fire due to overpressure. Explosion may result if vapors are ignited in a confined area by a strong ignition source. Contact with certain other materials may result in formation of explosive mixtures.

1005

3318

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas)
or Division 2.3 (Poison Gas)



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Teflon (PTFE)® and butyl rubber are reported to provide more than 8 hours of protection. Other compatible materials may include natural rubber, neoprene, nitrile rubber, and polyvinyl chloride. Material found to be incompatible with ammonia was Saranax®.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with an ammonia cartridge (500 ppm or less) with a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Reports vary regarding removal of clothing, due to possibility of frostbite. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas. Forcible removal of clothing frozen to skin may tear skin. If appropriate, thaw clothing before removal.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical; water fog or foam for large fires, if necessary. See note below on water use.

Extinguishing Techniques: Take into consideration the highly toxic nature of ammonia to aquatic organisms while planning the response. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Unusual vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. Note that addition of water to pools of liquid anhydrous ammonia may vastly increase vapor evolution.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extreme volatility and low boiling point of the product into account while planning the response. Beware of possible heavy gas concentrations in pits, hollows, and depressions.

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas) or Division 2.3 (Poison Gas)

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to anhydrous ammonia vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact pools of liquid anhydrous ammonia as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of anhydrous ammonia from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of anhydrous ammonia vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if initial increase in vapor evolution may affect downwind populations.

TECHNIQUE

DILUTION . . . The addition of a flooding quantities of water to liquid anhydrous ammonia may slow the release of vapors into the atmosphere. This response is best suited to smaller spills.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Proceed with caution. Consult qualified experts.

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas) or Division 2.3 (Poison Gas)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may confine spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Confined substance may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

AMMONIA, ANHYDROUS or AMMONIA SOLUTION

Division 2.2 (Non-Flammable Gas) or Division 2.3 (Poison Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination. Consult qualified experts for advice.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to the water may reduce environmental hazards.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

AMMONIUM HYDROXIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Ammonium hydroxide (NH_40H) is a colorless to milkly colored liquid that is formulated by dissolving ammonia (NH_3) in water. Various grades generally (but not always) contain 15-29.4% ammonia by weight and are used as household cleaners, for fertilizer, and in making plastics, dyes, explosives, detergents, pesticides, nitric acid, and other products. All are fully soluble in water and are not considered flammable. Nevertheless, ammonia vapors may evolve and burn if these solutions are heated in fires. Accumulations of ammonia vapor in confined spaces within a narrow range of concentrations may occasionally result in explosions if exposed to a strong source of ignition. There is some limited potential for containers of ammonium hydroxide to rupture due to overpressurization if exposed to fire or excessive heat for sufficient time duration. Concentrated solutions may boil at higher ambient temperatures and many solutions are capable of evolving significant amounts of toxic ammonia vapors. A solution containing 20% ammonia weighs about 7.7 pounds per gallon.

Ammonium hydroxide mixes in water with mild liberation of heat. It is corrosive to some metals and reacts with various chemicals. Mixtures with halogens, calcium, mercury, silver oxide, or hypochlorites of calcium or sodium may be explosive. The liquid and its concentrated vapors may be irritating and corrosive to bodily tissues. Products of combustion may include nitrogen oxides and unburned ammonia.

Downwind evacuation should be considered on a case by case basis if a concentrated solution of ammonium hydroxide is leaking from its container.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Data unavailable
Specific Gravity (Liquid): 0.9592 (10% NH_3); 0.9245 (20% NH_3); both at 68°F (20°C).
Boiling Point: 81°F (27.2°C) at 1 atm for 29.4% solution
Melting Point: –98.3°F (–72.4°C)
Freezing Point: –98.3°F (–72.4°C)
Molecular Weight: 35.05 for NH_4OH; 17.03 for NH_3
Heat of Combustion: –4440 cal/g for NH_3 vapor
Vapor Pressure: 556.7 mm Hg (10.76 psia) at 70°F (21.1°C) for 28.8%; 221.4 mm Hg (4.28 psia) for 19.1% NH_3
Flash Point: Not flammable under conditions likely to be encountered.
Autoignition Temperature: 1204°F (651°C) for NH_3 vapor
Burning Rate: Not pertinent
Stability: Stable
Corrosiveness: Corrosive to aluminum, tin, copper, lead, silver, zinc, galvanized surfaces, and various alloys of these metals.
Reactivity with Water: Mild liberation of heat upon dissolution.
Reactivity with Other Chemicals: Reacts with strong mineral acids, silver nitrate, silver oxide, silver oxide and ethyl alcohol, calcium, mercury, hypochlorites of calcium or sodium, acrolein, acrylic acid, dimethyl sulfate, halogens, gold, hydrochloric acid, nitric acid, hydrofluoric acid; B-propiolactone, propylene oxide, or silver permanganate.

IDENTIFICATION

Shipping Names: Ammonium hydroxide (USDOT); ammonia solution (USDOT and IMO)
Synonyms and Tradenames: Ammonia monohydrate; aqueous ammonia; ammonia solution; ammonia water; household ammonia; aqua ammonia; water of ammonia; ammonium hydrate.
Chemical Formula: NH_4OH
Constituent Components(% each): 15-29.4% ammonia in water (generally, not always)
UN/NA Designation: UN2073; UN2672; UN3318
IMO Designation: 8, corrosive (depending on NH_3 concentration)
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless or milky white
Odor Characteristics: Like ammonia, pungent
Common Uses: Mfg. plastics, dyes, explosives, detergents, pesticides, nitric acid, rayon, rubber, pharmaceuticals, inks, ceramics, lubricants, household cleaners, fertilizers, and other chemicals; used in refrigeration, photography, and fireproofing wood.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

AMMONIUM HYDROXIDE

Class 8 (Corrosive Material)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.037-20 ppm reported for NH_3

Unusual Hazards: May evolve considerable amounts of ammonia vapors from concentrated solutions or if heated. Concentrated solutions may boil at higher ambient temperatures.

Short Term Exposure Limits(STEL): 35 ppm NH_3 for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 25 ppm NH_3 over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and strong ignition sources; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high ammonia concentrations that may result in air from larger spills or spills of concentrated ammonium hydroxide. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of liquid ammonium hydroxide with the skin or eyes may cause intense irritation and possibly severe burns. The hazard is proportional to the amount of NH_3 in solutions, but even those with only 10% ammonia by weight should be considered highly hazardous. Ammonia vapors in air at high concentrations may also cause burns and blisters of the skin or eyes.

Hazards of Inhalation: Ammonia vapors may cause burning and tearing of the eyes, runny nose, coughing, chest pain, and irritation of the nose and throat. Severe exposures may result in difficult breathing, bronchospasm, bronchitis, pulmonary edema, and possibly death. Some effects may be delayed in onset and may be accompanied by pink frothy sputum. Note that a level of 5000 ppm in air may be almost immediately fatal due to serious edema, strangulation, and asphyxia.

Hazards of Ingestion: Ingestion may cause burning pain in mouth, throat, stomach, and thorax, constriction of throat and coughing. This may be followed by vomiting of blood or passage of bloody stools. Breathing difficulties, convulsions, and shock may result. Ingestion of only 3-4 ml may be fatal.

FIRE HAZARDS

Lower Flammable Limit: 15.5% (for NH_3)

Upper Flammable Limit: 27% (for NH_3)

Behavior in Fire: May generate large quantities of vapor upon release. Vapors will burn but are difficult to ignite. Containers may rupture in fire due to overpressurization.

Hazardous Combustion Products: May include oxides of nitrogen and unburned ammonia.

EXPLOSION HAZARDS

Lower Explosive Limit: 16% (for NH_3)

Upper Explosive Limit: 25% (for NH_3)

Explosiveness: Containers may rupture in fire due to overpressurization. Vapors are difficult to ignite but may occasionally explode if ignited by a strong source within a confined area. Contact with certain other chemicals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/sytrene-butadiene rubber, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, chlorinated polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, Viton, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm NH_3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted ammonia canister (500 ppm NH_3 or less) or an ammonia cartridge respirator with a full facepiece 300 ppm NH_3 or less) within the use limitations of these devices.

2672

AMMONIUM HYDROXIDE
Class 8 (Corrosive Material)

See UN/NA Designation for other ID numbers.

FIRST AID

Nonspecific symptoms: Irritation or burns of any bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes diffficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation is present after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Unusual vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account that concentrated ammonium hydroxide is volatile, toxic, corrosive, and potentially flammable under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ammonium hydroxide spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm weather and/or the product is fairly concentrated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Ammonium hydroxide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled, the product is not very concentrated, and/or the weather is cold.

CONSEQUENCE

Hazardous levels of ammonia in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

AMMONIUM HYDROXIDE
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb ammonia vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain ammonium hydroxide from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid ammonium hydroxide may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid ammonium hydroxide may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . There is a possibility that special chemical hazard foam or certain high expansion foams applied to the surface of liquid pools may slow the release of ammonia vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ammonium hydroxide may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained ammonium hydroxide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

AMMONIUM HYDROXIDE
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

AMMONIUM HYDROXIDE
Class 8 (Corrosive Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

AMMONIUM NITRATE
Division 5.1(Oxidizer)

GENERAL INFORMATION

Ammonium nitrate is an odorless solid that may be colorless, white, grayish white, gray, or brown depending upon purity and the presence of other substances. Although this guide is primarily for relatively pure grades, the information contained herein may be applicable to several solid mixtures with minimal organic content. The material is used in explosives, fertilizers, and a variety of other products.

Ammonium nitrate is heavier than water and quite soluble so may be expected to sink in water and rapidly dissolve (although other mixture components may not). It is not flammable, but is an oxidizer that supports the burning of combustible materials. One key hazard is that ammonium nitrate is capable of detonation if heated under confinement or if subjected to strong shocks such as those from an explosive. Sensitivity to detonation is enhanced by the presence of organic and other easily oxidizable matter, particularly if these are finely divided, and mixtures with fuel oil are used as blasting agents. Self-ignition of mixtures with organic materials or finely divided metals is possible at moderately elevated temperatures. Products of combustion include toxic oxides of nitrogen.

Evacuation for a radius of at least one-half (1/2) mile should be undertaken if a fire involving relatively pure ammonium nitrate becomes uncontrollable. A radius of at least one-third (1/3) mile is necessary if various mixtures are on fire, involved in fire, and/or a fire becomes uncontrollable. If the material is in a mixed load shipment (small packages shipped with other small packages in the same outer packaging, railcar, container, or trailer) and exposed to fire or direct flame, evacuate for a radius of one-third (1/3) mile. If bulk container is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, approx. 200 g/100 g water at 70°F (21.1°C)

Solubility in Other Chemicals: Soluble in acetone; slightly soluble in alcohols.

Specific Gravity (Solid): 1.72 at 68°F (20°C)

Boiling Point: Decomposes

Melting Point: 337.3 (169.6°C)

Freezing Point: 337.8°F (169.9°C)

Molecular Weight: 80.05

Heat of Combustion: Not pertinent

Vapor Pressure: Unavailable; probably very low.

Flash Point: Not pertinent

Autoignition Temperature: Not pertinent

Burning Rate: Not pertinent

Stability: Decomposes if heated strongly, giving off toxic gases that support combustion. May detonate if heated under confinement.

Corrosiveness: Data unavailable; not very pertinent.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Incompatible and may react with acids; organic combustibles; powdered metals such as zinc, copper, or aluminum; flammable or combustible liquids; corrosives; chlorates; sulfur or phosphorus; charcoal, coke, cork, or sawdust; phosphorus; reducing agents; chlorides; and other chemicals.

IDENTIFICATION

Shipping Names: Ammonium nitrate (no organic coating) (USDOT); ammonium nitrate (organic coating) (USDOT); ammonium nitrate, solution (USDOT); ammonium nitrate fertilizer (USDOT); ammonium nitrate mixed fertilizer (USDOT); ammonium nitrate-phosphate (USDOT); ammonium nitrate-carbonate mixture (USDOT); ammonium nitrate (IMO); ammonium nitrate fertilizer, N.O.S (IMO); ammonium nitrate fertilizers (IMO).

Synonyms and Tradenames: Nitric acid, ammonium salt; Nitram.

Chemical Formula: NH_4NO_3

Constituent Components(% each): Various grades and mixtures.

UN/NA Designation: UN1942, UN2426, UN2067, UN2071, NA2072, NA2069

IMO Designation: 1.1, explosive; 5.1, oxidizing substance; or 9, misc. dangerous substance, depending on form.

Physical State as Shipped: Solid or solution

Physical State as Released: Solid or solution

Color of the Shipped Material: Colorless, white, grayish white, gray, or brown

Odor Characteristics: Odorless

Common Uses: Medical; explosives; fertilizers; matches and pyrotechnics; herbicides and insecticides; mfg. of nitrous oxide, freezing mixtures, solid rocket propellants; catalyst; nutrient for antibiotics to yeast; sorbent for nitrogen oxides.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

AMMONIUM NITRATE

Division 5.1(Oxidizer)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not pertinent

Unusual Hazards: May detonate under appropriate conditions. See General Information section.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat or fire; contact with incompatible materials; poorly ventilated confined spaces; water contamination; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Generally of limited health hazard when pure. Excessive contact, inhalation, or ingestion should nevertheless be avoided. Exposure may cause allergic reactions.

Hazards of Skin or Eye Contact: Ammonium nitrate may be irritating to the skin and eyes upon contact and may cause burns. It is not, however, considered to be a severe irritant.

Hazards of Inhalation: Dust of ammonium nitrate is irritating to the mucous membranes of the respiratory tract. Excessive exposure may result in urination and acidic urine, severe lung congestion, coughing, difficult breathing, systemic acidosis, and metheglobinemia (abnormal blood hemoglobin). Observe victim for delayed chemical pneumonitis or pulmonary edema.

Hazards of Ingestion: Ingestion may cause urination and acidic urine. Large amounts may cause systemic acidosis and metheglobinemia.

FIRE HAZARDS

Lower Flammable Limit: Not pertinent

Upper Flammable Limit: Not pertinent

Behavior in Fire: Decomposes when heated strongly to emit toxic gases that support combustion. May detonate if in a confined area permitting pressure buildup.

Hazardous Combustion Products: Include highly toxic nitrogen oxides.

EXPLOSION HAZARDS

Lower Explosive Limit: Not pertinent

Upper Explosive Limit: Not pertinent

Explosiveness: Capable of detonation if heated under confinement, exposed to strong shock, and or if contaminated with organic or other easily oxidizable matter such as fuel oil, charcoal, or other incompatible substances.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an approved particulate (dust) respirator may be adequate within the use limitations of these devices.

FIRST AID

Nonspecifc symptoms: Irritation of the eyes, nose, skin, or respiratory tract; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention.

First Aid for Ingestion: Data unavailable. Get medical attention immediately.

2426

See UN/NA Designation for
other ID numbers.

AMMONIUM NITRATE
Division 5.1(Oxidizer)

FIRE RESPONSE

Extinguishing Materials: Use flooding amounts of water but control runoff. Exercise caution when applying water to fused or molten material to avoid eruptive scattering and spread of fire.

Extinguishing Techniques: Special explosion hazard. Stay upwind and at protected location. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk and if cargo has not been exposed to heat. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Give special attention to the explosive properties of ammonium nitrate while planning the response

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Ammonium nitrate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ammonium nitrate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid ammonium nitrate with a compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may reduce levels of ammonium nitrate dust in air.

CONSEQUENCE

Water runoff may contain varying amounts of ammonium nitrate from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

AMMONIUM NITRATE
Division 5.1(Oxidizer)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ammonium nitrate solutions may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ammonium nitrate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. Keep solid product dry possibly by coverage with a compatible material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

AMMONIUM NITRATE

Division 5.1(Oxidizer)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

September 1992

AMMONIUM SULFATE
Non-Regulated

GENERAL INFORMATION

Ammonium sulfate is not designated as a hazardous material in transportation but nevertheless has potential to cause injury and/or environmental pollution if improperly handled. It is consistently ranked among the top 35 chemicals produced in the United States and may therefore be encountered comparatively frequently in transportation or other accidents resulting in a chemical discharge.

Ammonium sulfate is usually shipped as solid white to brownish-gray crystals or granules or as a clear liquid solution in water containing around 38% ammonium sulfate by weight. Neither the solid or its aqueous solutions are combustible. The vapor pressure of the pure solid is extremely low at room temperatures and the product is often odorless, though some grades may have a slight odor of ammonia. It is used as an agricultural fertilizer and has a variety of other diverse uses in commerce. Solid ammonium sulfate is highly but not completely soluble in water and heavier; aqueous solutions will mix freely with water in all proportions. The solid weighs about 110.5 pounds per cubic foot; a 38% solution weighs about 10 pounds per gallon.

Ammonium sulfate does not react with water and is stable in normal transportation. Reactions with strong oxidizing agents may result in fires or explosions under appropriate conditions and the substance is also reported to be incompatible with zinc and copper-containing metals, alkaline materials, and strong acids. In addition, ammonium sulfate exhibits corrosiveness towards concrete and cement. It may possibly attack some forms of plastics, rubber and coatings, but this could not be confirmed. Toxicity of the product is generally low by all routes of exposure but products of thermal decomposition at elevated temperatures include several that are toxic and/or irritating.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; about 75.4 g/100 g water at 68°F (20°C). This forms a 43% solution of ammonium sulfate in water by weight at this temperature.

Solubility in Other Chemicals: Insoluble in acetone, alcohol, ammonia, and carbon bisulfide.

Specific Gravity: 1.77 at 68°F (20°C) for solid; 1.2 for 38% solution in water. The bulk density of the solid (including air between particles) is reported by one authority to be about 0.89 at 59°F (15°C).

Boiling Point: Decomposes; see melting point

Melting Point: Several authorities report that ammonium sulfate decomposes at temperatures of 455°F (235°C) or above; several others indicate decomposition occurs at 536°F (280°C) or above; one says 662°F (350°C) or above. Two acknowledge decomposition at temperatures of 536°F or above but provide a melting point of 955°F (513°C). This property of ammonium sulfate is clearly not well defined in the literature.

Freezing Point: See melting point

Molecular Weight: 132.14

Heat of Combustion: Not combustible

Vapor Pressure: Negligible at 68°F (20°C)

Flash Point: Not combustible

Autoignition Temperature: Not combustible

Burning Rate: Not combustible

Stability: Stable at normal temperatures

Corrosiveness: Reported as incompatible with zinc-clad (e.g., galvanized) metals, copper, brass, bronze, and other copper-bearing materials, but reasons for these statements could not be determined. Increases the corrosiveness of water towards concrete. Sulfates in excess of 300 ppm in soil and water are detrimental to asbestos-cement and asbestos-concrete pipes. The product may possibly attack some forms of plastics, rubber and coatings, but this could not be confirmed.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Contact with strong oxidizing materials may result in fire or explosion under appropriate conditions. Additionally, ammonia gas may evolve if ammonium sulfate contacts alkaline materials. The product is reported as incompatible with zinc-clad, copper, brass, bronze, and other copper-bearing metals, as well as strong acids, but details are not provided as to the nature and/or severity of the incompatibility.

IDENTIFICATION

Shipping Names: No particular name is standard but "Chemicals, n.e.c." is a possibility. The shipper may or may not provide the specific chemical name of the product.

Synonyms and Tradenames: Ammonium hydrogen sulfate; diammonium sulfate; dolamin; sulfuric acid, diammonium salt; mascagnite. The word "sulphate" may be found in place of "sulfate" in the names of this product.

Chemical Formula: $(NH_4)_2S0_4$

Constituent Components (l each): The purest grades of the solid contain at least 99% ammonium sulfate. At least one maker of the product ships it as a 38% solution in water.

28 STCC: 28 191 55

UN/NNA Designation: Not established

IMO Designation: Not established

Physical State As Shipped: Solid crystals or granules; solutions in water.

Physical State As Released: *As* shipped

Color of the Shipped Material: White to brownish-gray crystals or granules depending on degree of purity; generally colorless solutions in water.

Odor Characteristics: Commonly odorless but some commercial products may have a slight smell of ammonia.

Common Uses: Used as agricultural fertilizer; used for making other chemicals, synthetic flavors, proteins, freezing mixtures, and viscose rayon and silk.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

AMMONIUM SULFATE
Non-Regulated

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless or with slight odor of ammonia. Threshold concentrations reported for ammonia range from 0.037 ppm to 20 ppm.

Unusual Hazards: Products of thermal decomposition are far more hazardous than ammonium sulfate itself with respect to inhalation hazards.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limits: 10 mg/m^3 (total dust) over each 8 hours of a 40 hour work week (ACGIH TLV, 1990–91); 15 mg/m^3 (as total dust) and 5 mg/m^3 (as respirable fraction) under similar circumstances (OSHA PEL, 1989); all as exposure limits for "nuisance dusts".

Conditions to Avoid: Excessive heat or fire; contact with incompatible materials or contamination of any kind; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Health hazards attributable to ammonium sulfate under normal conditions are comparatively minimal in the case of episodic spills into the environment, but it is always prudent to minimize unnecessary exposures to chemical substances.

Hazards of Skin or Eye Contact: Contact of the eyes with ammonium sulfate dust or mist may result in irritation but is not reported to injure eye tissue. Frequent or prolonged contact of the product with the skin is reported to cause a low level of irritation; a brief contact may cause some degree of dryness of the skin. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Inhalation of ammonium sulfate dust or mist, particularly at high concentrations in air, is reported to cause relatively slight irritation of the nose, throat, and lungs. Excessive exposures may cause some degree of coughing and chest discomfort.

Hazards of Ingestion: Ammonium sulfate is of generally low toxicity by ingestion. The LD50 for rats, the dosage reported to kill 50% of the animals in laboratory experiments, is 3 grams per kilogram of the animal's body weight. A human male estimated to have ingested 1.5 grams per kilogram of body weight is reported to have suffered diarrhea, nausea and/or vomiting, and other effects on the gastrointestinal tract. Various references report expected symptoms of ingestion to include irritation of the mouth, throat and stomach, digestive tract disorders and/or damage, abdominal pain, nausea, muscle contractions or spasticity, tremors, drowsiness, dilated pupils, and respiratory system stimulation.

FIRE HAZARDS

Lower Flammable Limit: Not combustible

Upper Flammable Limit: Not combustible

Behavior in Fire: Neither the solid product or its solutions in water are combustible.

Hazardous Combustion Products: Although ammonium sulfate is not combustible, it decomposes at high temperatures and evolves irritating and/or very highly toxic gases such as ammonia, sulfur dioxide, sulfur trioxide, and/or oxides of nitrogen. Certain sulfur oxides may combine with moisture in air to form sulfurous and sulfuric acid fumes. Certain nitrogen oxides may similarly form nitrous and nitric acid fumes. Yet other oxides of nitrogen may be strong oxidizing agents.

EXPLOSION HAZARDS

Lower Explosive Limit: Not combustible

Upper Explosive Limit: Not combustible

Explosiveness: Contact with other chemicals, particularly strong oxidizing agents, may result in explosions. See Behavior in Fire section directly above for a discussion of container rupture potential.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber or plastic gloves, long-sleeved shirts, trousers, safety shoes, rubber aprons, face shields, safety goggles, and other appropriate clothing as necessary to provide adequate protection under their circumstances of use. Compatible materials for ammonium sulfate may

PROTECTIVE CLOTHING AND EQUIPMENT (continued)

Protective Clothing Required (continued): include butyl rubber, natural rubber, neoprene, nitrile rubber, polyvinyl chloride (PVC), polyurethane, and styrene-butadiene rubber (SBR).

Respiratory Protection: For fire fighting or when in confined areas, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Where deemed necessary due to high concentrations of ammonium sulfate dust or mist in air, a NIOSH-approved dust or mist respirator appropriate for the airborne contaminant levels present and used within the limitations of these devices. Note that protection may not be necessary if the product has spilled in a non-fire situation and its dusts or mists have not become airborne.

FIRST AID

Nonspecific Symptoms: Irritation of the skin, eyes, nose, throat, or upper respiratory tract; coughing and/or chest discomfort; various symptoms of ingestion.

First Aid for Inhalation: Unlikely to be necessary unless victim has been exposed to the thermal decomposition products of ammonium sulfate. If necessary, remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have victim lean forward with head below hips to prevent aspiration of fluids into lungs. See the Emergency Action Guide for "Nitric Oxide" or "Nitrogen Tetroxide" for additional information where exposures to oxides of nitrogen may have occurred.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention if eye or skin irritation persists after washing.

First Aid for Ingestion: Ammonium sulfate is of relatively low toxicity by ingestion but may nevertheless have adverse effects if ingested in significant quantities. Conversely, entry into the lungs due to aspiration during vomiting may also have adverse effects due to the irritating nature of the product. Most authorities agree that the victim should be administered at least two glasses of water if conscious. Beyond this point, they are divided as to whether or not vomiting should be induced. Get immediate advice from a physician as soon as possible on this issue and/or get the victim immediate medical attention. Do not make an unconscious person vomit under any circumstances. If instructed to induce vomiting or vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: According to several authorities, most fire extinguishing agents may be used in fires involving ammonium sulfate.

Extinguishing Techniques: Stay upwind. Avoid bodily contact.' Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with concentrated gases or fumes from thermally decomposing ammonium sulfate may be:anticipated. Move container from fire area if no risk. Use professional judgment to decide if sealed metal drums or other containers or tanks exposed to excessive heat or fire should be kept cool via use of water sprays to avoid the possibility of container rupture due to buildup and pressurization of gases or steam in the container. If deemed necessary, use water from side and from safe distance to keep containers cool until well after fire is out. For a massive fire in the cargo area under these circumstances, it may be prudent to use unmanned hose holders or monitor nozzles. In any case, stay away from ends of tanks involved in a fire but realize that shrapnel may travel in any direction. See earlier discussions about the decomposition of ammonium sulfate at elevated temperatures and the highly toxic and irritating gases and fumes that may be evolved into the atmosphere. Such decomposition may possibly be reduced or eliminated if exposed solid ammonium sulfate is intentionally wet down with water and maintained in a wet condition, and if solutions are not permitted to evaporate to dryness. Although this action may lead to spread of contamination unless runoff can be contained, it may reduce overall risks to the public in some cases.

SPILL RESPONSES

***General* Information:** Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop discharge if safe to do so. Prevent substance from entering sewers and

SPILL RESPONSES (continued)

General Information (continued): water bodies. Protect sewers and waterways from contaminated runoff: Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or other hazard to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Consult environmental authorities for advice with respect to disposal options; the solid and its solutions may often be suitable for local use as agricultural fertilizers. Take the high toxic hazard of the thermal decomposition products of ammonium sulfate into account while planning the response if the substance may be exposed to fire or high temperatures. Note that ammonium sulfate can be toxic to some kinds of aquatic life at fairly low concentrations in water.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Ammonium sulfate and its solutions in water do not appear capable of generating significant amounts of hazardous airborne contaminants in most non-fire spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed. (Note: In order to pose a significant downwind inhalation hazard, large quantities of dusts or mists must somehow become airborne and/or toxic products of thermal decomposition must be evolved into the atmosphere.)

CONSEQUENCE

Some levels of ammonium sulfate dust or mist may possibly be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow gases and fumes to dissipate where thermal decomposition products of ammonium sulfate are evolved into the atmosphere. These products may be toxic over considerable downwind distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop thermal decomposition of the ammonium sulfate if safe to do so (see earlier "Extinguishing Techniques" section). When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid ammonium sulfate with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Where deemed necessary, water fog or spray applied to ammonium sulfate dust or mist in air may knock them down. Apply water at a point downwind if practical if solid ammonium sulfate is exposed to prevent dissolution in water and spreading of contamination.

CONSEQUENCE

Water runoff may contain varying amounts of ammonium sulfate from contact with the dust or mist.

TECHNIQUE (continued)

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination where deemed necessary. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of solid ammonium sulfate, its solutions, or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate means.

CONSEQUENCE

Any contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.,

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product, particularly solutions or contaminated runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Certain metals are incompatible with ammonium sulfate.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of liquids may be controlled by absorbing them with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil, spilled product, and its residues may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines where deemed necessary.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause

TECHNIQUE (continued)

CONSEQUENCE (continued)

ammonium sulfate dust to become airborne. Hot surfaces of motorized equipment may cause thermal decomposition of ammonium sulfate if contaminated, thus resulting in evolution of highly toxic and irritating gases and fumes.

MITIGATION

Select removal techniques that do not cause dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply appropriate precautions if use of motorized equipment may result in the heating and thermal decomposition of ammonium sulfate. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid ammonium sulfate will sink in water and dissolve at a fairly rapid rate, particularly if water is plentiful compared to the amount of product spilled. Aqueous solutions of ammonium sulfate will dissolve freely in water. Note that the pH of a solution consisting of 10 grams of ammonium sulfate mixed with 100 grams of water is about 5; the pH of a 0.1 molar solution is 5.5. Ammonium sulfate dissolved in water may be toxic to various species of aquatic life at relatively low to moderate concentrations in water. Chlorination of water containing ammonium sulfate causes formation of odorous chloramines, these being the substances that typically cause the "chlorine" smell in swimming pools.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap solid ammonium sulfate on bottom and limit spread of contamination where it appears an opportunity may exist to recover a portion of the material before it dissolves in water.

CONSEQUENCE

Excavation of a deep water pocket or lagoon downstream of the spill area may be difficult and may have adverse environmental impacts. The technique may only be effective where the flow of water is relatively low compared to the amount of solid spilled.

MITIGATION

Use professional judgment to determine if application of this technique is likely to be beneficial in product recovery. Excavate lagoons as a last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water solids that have not dissolved or contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION .

Consult qualified experts for guidance. Use compatible equipment.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

CHEMICAL TREATMENT . . . Application of appropriate chemical agent(s) to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating contaminated water via a processing system constructed on land.

March 1995

AMMONIUM SULFIDE SOLUTION

Class 8 (Corrosive Material)

GENERAL INFORMATION

True ammonium sulfide is only stable in the absence of moisture at temperatures below 32°F (0°C). Consisting of yellow crystals, the substance decomposes upon melting into several different compounds.

The ammonium sulfide shipped and used in commerce is largely ammonium hydrosulfide (also known as ammonium bisulfide) dissolved in water. Such solutions range from colorless to yellow to red or orange and have a strong odor of hydrogen sulfide (like rotten eggs) and ammonia, these being two gases that evolve from the product. Yellow solutions are actually colorless when first made but later yellow with age due to the formation of polysulfides. They usually correspond to about 16 - 20% solutions of ammonium sulfide, while red solutions correspond to about 30% strengths. All solutions are fully soluble in water and weigh on the order of 9 pounds per gallon. They are used to color brass and bronze, and in making textiles, photo developing fluids, synthetic flavors, and various other products.

The hazardous properties of these solutions are not well-defined in the general literature. They are classified as flammable liquids, however, and should be assumed to be volatile in the absence of more detailed information. Thus, be advised that these solutions may be easily ignited under a variety of environmental conditions. Vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is a possibility that containers may rupture violently if exposed to fire or excessive heat for sufficient time duration.

Ammonium sulfide solutions do not react with water or many other common materials and are considered stable in transportation (except for the fact that toxic hydrogen sulfide and ammonia gases may collect in enclosed spaces). Solutions are severely corrosive to copper and zinc and their alloys (including brass) and may otherwise react with a wide variety of other chemicals. Reactions with acids or their fumes, in particular, may evolve large quantities of hydrogen sulfide. The product is severely irritating and toxic via the various routes of exposure. Products of thermal decomposition or combustion include several highly toxic constituents. Please refer to the Emergency Action Guides for ammonia and hydrogen sulfide for further information on the hazardous properties of these gases in air.

If an ammonium sulfide solution is leaking (not on fire) and generating vapors or fumes, evacuation of the immediate spill area and downwind should be considered until properly equipped responders have evaluated the hazard. If a fire is prolonged or uncontrollable, or if a container is exposed to direct flame, evacuate for a radius of one-half ($^{1}/_{2}$) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: The solution is soluble in all proportions.

Solubility in Other Chemicals: True ammonium sulfide is soluble in alcohol, alkalies, and ammonia. Ammonium hydrosulfide is soluble in alcohol and ammonia.

Specific Gravity (Liquid): 0.99–1.01 at 68°F (20°C)

Boiling Point: 104°F (40°C) reported for unspecified composition; 91.9°F (33.3°C) for pure ammonium hydrosulfide.

Melting Point: Unavailable

Freezing Point: Unavailable

Molecular Weight: 68.14 for pure ammonium sulfide; 51.11 for ammonium hydrosulfide.

Heat of Combustion: Unavailable

Vapor Pressure: 400 mm Hg (7.732 psia) for pure ammonium hydrosulfide at 71.2°F (21.8°C)

Flash Point: 72°F (22.2°C), closed cup, reported for unspecified composition.

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable, but toxic hydrogen sulfide and ammonia gases may collect in enclosed spaces.

Corrosiveness: Severely corrodes copper, zinc, and their alloys including brass and bronze.

Reactivity with Water: No reaction but some amount of heat is generated when the pure compound is first dissolved in water.

Reactivity with Other Chemicals: Inompatible with strong oxidizers, alkalies, and aluminum. Contact of the solution with acids or acid fumes liberates toxic hydrogen sulfide gas. Reactions of ammonium salts in general with potassium chlorate or molten nitrite salts can be violent or explosive. Inorganic sulfides can also be considered strong reducing agents that are generally reactive with a wide variety of other chemicals.

IDENTIFICATION

Shipping Names: Ammonium sulfide solution (USDOT); ammonium sulphide, solution (IMO).

Synonyms and Tradenames: Ammonium mercaptan; ammonium bisulfide, ammonium hydrogen sulfide; ammonium hydrosulfide; ammonium sulfhydrate; diammonium sulfide.

Chemical Formula: $(NH_4)_2S$ for pure ammonium sulfide; NH_4HS for ammonium hydrosulfide.

Constituent Components (% each): Usually 20 –60% solution of ammonium sulfide in water.

UN/NA Designation: UN2683

IMO Designation: 8 corrosive

Physical State As Shipped: *Usually liquid*

Physical State As Released: Usually liquid

Color of the Shipped Material: Colorless to yellow, red or orange depending on age and concentration. Odor ***Characteristics:*** Strong odor of rotten eggs (sulfide) and ammonia.

Common Uses: Textile manufacture, trace metal analysis, coloring brass and bronze, photo developers, synthetic flavors, iron control in soda ash production.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

AMMONIUM SULFIDE SOLUTION

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: A toxic, flammable, and somewhat corrosive liquid that is of variable composition and for which available data are very limited.

Short Term Exposure Limits (STEL): Unavailable; 35 ppm for ammonia and 15 ppm for hydrogen sulfide for 15 minutes (ACGIH).

Time Weighted Average (TLV-TWA): Unavailable; 25 ppm for ammonia and 10 ppm for hydrogen sulfide over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the significant vapor or fume concentrations that may be present in air in the spill area and over some distance downwind. Direct physical contact and ingestion should also be strictly avoided.

Hazards of Skin or Eye Contact: Contact with ammonium sulfide solution causes softening of the skin and severe irritation and or burns. The liquid may be absorbed through the skin and cause hydrogen sulfide poisoning. Contact with liquid ammonium sulfide solution may cause severe burns of the eyes.

Hazards of Inhalation: Inhalation of 500 ppm of ammonium sulfide solution vapors or fumes in air for 30 minutes may cause headache, dizziness, coughing, difficult breathing, pulmonary edema (which may be delayed in onset) and/or bronchial pneumonia. Exposure to 600 ppm for 30 minutes may be fatal.

Hazards of Ingestion: Ammonium sulfide solution is considered to be highly toxic when ingested due to the nausea, irritation, and tissue corrosion caused by liberation of hydrogen sulfide. Mucous membranes and the stomach may be severely irritated or burned.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquid. May generate large quantities of flammable gas or vapor upon release. Vapors may travel some distance to a source of ignition and flash back. There is a possibility that containers may rupture violently in fire.

Hazardous Combustion Products: Decomposes at high temperatures and/or when burned into ammonia, hydrogen sulfide, polysulfides, sulfur oxides, nitrogen oxides, and other toxic compounds.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is a possibility that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with ammonium sulfide solution. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. A maker of ammonium sulfide solution indicates that compatible materials may include polyvinyl acetate.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2683 AMMONIUM SULFIDE SOLUTION

Class 8 (Corrosive Material)

FIRST AID

Nonspecifc Symptoms: Irritation or burns of bodily tissues, headache, dizziness, nausea, coughing, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, appropriate type of foam. Water may be ineffective but may be used to dilute spill to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture, explosion, or damage to boilers or industrial process equipment. Use explosion-proof and spark-proof equipment and tools where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the toxic, flammable, and corrosive nature of ammonium sulfide solution into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ammonium sulfide solution spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled, the product is warm, and/or the solution is highly concentrated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

AMMONIUM SULFIDE SOLUTION

Class 8 (Corrosive Material)

TECHNIQUE

MONITOR THE SITUATION . . . Ammonium sulfide solutions may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of various toxic gases may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ammonium sulfide solution vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain ammonium sulfide or other chemicals from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid ammonium sulfide solutions may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of ammonium sulfide solution vapors into the atmosphere, but various sources disagree on which type of foam is most appropriate.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid ammonium sulfide solution may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques. Note that application of acid may generate large quantities of toxic hydrogen sulfide gas unless properly conducted.

AMMONIUM SULFIDE SOLUTION

Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ammonium sulfide solutions may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained ammonium sulfide solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques. Note that application of an acid may generate large quantities of toxic hydrogen sulfide gas unless properly conducted.

AMMONIUM SULFIDE SOLUTION
Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land. Note that application of acid may generate large quantities of toxic hydrogen sulfide gas unless properly conducted.

March 1995

ANILINE OIL
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Aniline oil, also simply called aniline, is a colorless to brown liquid used in making dyes, solvents, vulcanizing agents, resins, pharmaceuticals, varnishes, perfumes, inks, nylon fiber, shoeblack, and a variety of other chemicals and products. It has a peculiar, musty or fishy odor, is barely heavier than water, and is somewhat soluble. Its flash point of 158°F indicates the product must be moderately heated before ignition may occur easily. The product weighs approximately 8.5 pounds per gallon .

Aniline oil does not react with water or many other common materials and is stable in normal transportation. It is reactive with various other chemicals and may be corrosive to copper, copper alloys, and brass. It is a highly toxic substance and is considered to be a poison. Products of combustion may be toxic and may include nitrogen oxides as well as unburned aniline oil.

Downwind evacuation should be considered if aniline oil is leaking from its container but not on fire. However, since the product is of low volatility, judgments are required on a case by case basis.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Somewhat soluble, 3.5 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and carbon tetrachloride.

Specific Gravity (Liquid): 1.022 at 68°F (20°C)

Boiling Point: 363.6°F (184.2°C) at 1 atm

Melting Point: 20.7°F (–6.3°C)

Freezing Point: 20.7°F (–6.3°C)

Molecular Weight: 93.13

Heat of Combustion: –8320 cal/g

Vapor Pressure: 0.6 mm Hg (0.012 psia) at 68°F (20°C)

Flash Point: 158°F (70°C), closed cup; 168°F (75.6°C), open cup.

Autoignition Temperature: 1418°F (770°C)

Burning Rate: 3.0 mm/minute

Stability: Stable

Corrosiveness: May attack copper, copper alloys, brass, and some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with nitrobenzene and glycerin, ozone, perchloric acid and formaldehyde, potassium or sodium peroxide, diisocyanates, strong acids or oxidizers, acetic anhydride, tri-or hexachloromelamine, perchromates, beta-propiolactone, and certain other chemicals.

IDENTIFICATION

Shipping Names: Aniline (USDOT & IMO).

Synonyms and Tradenames: Benzenamine; aniline; aminobenzene; phenylamine; aminophen; anilin; Blue oil; Anyvim; Kyanol.

Chemical Formula: $C_6H_5NH_2$

Constituent Components(% each): 99.5% pure in commercial grade

UN/NA Designation: UN1547

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid, freezes at 20.7°F

Physical State as Released: Liquid, freezes at 20.7°F

Color of the Shipped Material: Colorless to pale yellow or brownish

Odor Characteristics: Aromatic, amine-like; peculiar; musty, fishy, oily.

Common Uses: Dyes, varnishes, solvents, vulcanizing agent, resins, shoeblack, pharmaceuticals, perfumes, inks, sweetening agents, nylon fibers, photographic and agricultural chemicals, and other chemicals and products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ANILINE OIL

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.096-1.07 ppm

Unusual Hazards: Highly toxic substance that affects the ability of blood to carry oxygen. Readily absorbed through intact skin to cause toxic effects. Effects are more dangerous than readily apparent and may be delayed up to 4 hours.

Short Term Exposure Limits(STEL): 5 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 2 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Aniline oil is highly toxic by all potential routes of exposure.

Hazards of Skin or Eye Contact: Even small amounts of aniline oil can be rapidly absorbed through the skin to cause cyanosis (see below) with first symptom typically a headache. The liquid is mildly irritating to the skin or eyes, but eye contact may result in some degree of corneal damage.

Hazards of Inhalation: Causes cyanosis and thereby affects the ability of the blood to carry oxygen. Symptoms include bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, drowsiness, shortness of breath, unconsciousness, and possibly death if treatment is not prompt. Effects may be delayed up to 4 hours. Levels as low as 7-53 ppm in air may cause some symptoms.

Hazards of Ingestion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 1.3%

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite. May generate highly toxic vapors when hot.

Hazardous Combustion Products: May include toxic nitrogen oxides and unburned aniline.

EXPLOSION HAZARDS

Lower Explosive Limit: 1.3%

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from hot liquid are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

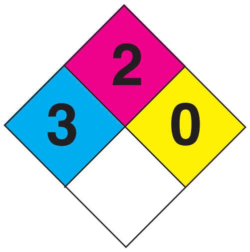
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, natural rubber, neoprene, nitrile rubber, polyethylene, chlorinated polyethylene, polyvinyl alcohol, styrene-butadiene rubber, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gasmask with chin-style or front or back mounted organic vapor canister (100 ppm or less) or an organic vapor cartridge respirator with a full facepiece (100 ppm or less) within the use limitations of these devices.

1547

ANILINE OIL

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific symptoms: Headache or other symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention as necessary to cleaning hair and scalp, finger and toenails, nostrils, and ear canals.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray.

Extinguishing Techniques: Unusual toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the special toxic properties of aniline oil fully into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Aniline oil spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts have spilled or the product is hot.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Aniline oil may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of aniline oil in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel

ANILINE OIL
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to aniline oil vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount of aniline oil from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of aniline oil vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Aniline oil may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained aniline oil may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

ANILINE OIL
Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contammation.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal .

ANILINE OIL
Division 6.1 (Poisonous Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 1992

ARGON
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Argon is a colorless, odorless, nonflammable and nontoxic element of nature that makes up about 0.93% of the atmosphere by volume and is handled as a compressed gas under high pressure or as a refrigerated liquid at extremely low temperatures. It is used as an inert gas in many industrial operations including arc welding, metal finishing, and growing high purity crystals for semiconductors, and is also employed in Geiger counting tubes, lasers, and certain types of electric lamps. Due to its very slight solubility in water and boiling point of approximately – 302°F, spills of liquefied argon on land or water or ruptures of compressed gas containers may quickly generate large quantities of heavier than air gas that may persist for a time in pits, hollows, and depressions. These may appear white at first due to condensation of water vapor in the air. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The refrigerated liquid weighs approximately 11.7 pounds per gallon at its normal boiling point temperature.

Due to the fact that the compressed gas is shipped at temperatures far in excess of its very low critical temperature, the pressure within containers of compressed gas is a function of the temperature of the container and the amount of argon it contains (such that the term "vapor pressure" no longer has meaning). These pressures can vary widely but are typically in the range of 121 to 409 atmospheres (1775 – 6000 psig) at room temperature within gas cylinders.

Argon is an inert substance that does not react with other materials and is fully stable. Although it is completely nontoxic, the large volumes of gas that may be generated in a major accident may cause suffocation by displacing oxygen in the air. The extremely low temperatures that may occur under certain conditions of release (primarily but not exclusively from discharges of liquid) may cause tissue damage and burns due to frostbite.

Note: Ordinary argon is composed of three stable isotopes. A fourth isotope, argon 37, is a radioactive gas that produces ionizing but not gamma radiation and which has a half-life of 35.1 days. This guide is solely intended for use with the more common non-radioactive argon isotopes.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 5.6 ml (gas)/ 100 ml water at 32°F (0°C); 3.36 ml (gas)/100 ml water at 68°F (20°C).

Solubility in Other Chemicals: Soluble as a gas to some extent in organic liquids

Specific Gravity (Liquid): 1.40 at normal boiling point

Boiling Point: – 302.6 to – 302.3°F (–185.9 to –185.7°C) at 1 atm.

Melting Point: – 308.9 to –308.6°F (–189.4 to –189.2°C)

Freezing Point: See melting point

Molecular Weight: 39.95

Heat of Combustion: Not flammable

Vapor Pressure: See General Information section above.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Noncorrosive; requires no special materials of construction so long as temperatures and pressures are tolerated.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: None; not known to combine with any other element; considered inert.

IDENTIFICATION

Shipping Names: Argon (USDOT and IMO); argon, refrigerated liquid (USDOT and IMO); argon, compressed (USDOT)

Synonyms and Tradenames: None, argon is one of the natural elements

Chemical Formula: Ar or A (monatomic gas)

Constituent Components (l each): More than 99.99% pure

49 STCC: 49 045 02 (argon or compressed argon);49 045 03 (refrigerated liquid)

UN/NADesignataon: UN1006 (argon or compressed argon); UN1951 (refrigerated liquid)

IMO Designation: 2.2, nonflammable gas

Physical State As Shipped: Compressed gas or refrigerated liquid

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Odorless

Common Uses: Arc welding; filling electric lamps; flushing and blanketing agent in metal refining; in Geiger counting tubes, lasers, and thermometers; furnace brazing; growing high purity crystals for semiconductors; general use as inert gas.

ARGON
Division 2.2 (Nonflammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Large volumes of nontoxic and nonflammable gas generated upon release may cause suffocation via displacement of oxygen in air at high concentrations. Extreme cold of liquid or vapors may cause tissue damage or burns due to frostbite. There is a possibility that temperatures may be low enough under some conditions to condense and liquefy some amount of oxygen from air on the surface of equipment containing liquid argon. Heavier than air gas may persist for a time in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable; see below

Time Weighted Average (TLV-TWA): Unavailable; listed as simple asphyxiant.

Conditions to Avoid: Entry into any area in which oxygen levels may be reduced unless a self-contained breathing apparatus (SCBA) is worn. Contact with cold liquid, gas, or containment equipment. Use of equipment not suitable for the temperatures and pressures that may be encountered.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from asphyxiation due to the high gas concentrations that may be present in air in the immediate spill area. Contact with extremely cold liquid, gas, or containment equipment should be avoided to prevent tissue damage and burns due to frostbite.

Hazards of Skin or Eye Contact: Contact with liquid argon or very cold argon gas may cause extensive tissue damage or burns due to the extremely low temperatures involved. Blistering and deep tissue freezing may occur from excessive contact.

Hazards of Inhalation: High concentrations of argon gas in air may cause suffocation by diluting the concentration of oxygen in air below levels necessary to support life. Lack of oxygen may produce dizziness, nausea, errors in judgment, fatigue, accelerated pulse, gasping, confusion, vomiting, headache, loss of consciousness and death, possibly in seconds and without warning. Dangers increase as oxygen levels drop below 18 percent by volume in air.

Hazards of Ingestion: Ingestion of liquid argon is highly unlikely.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable compressed gas or refrigerated liquid. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of gas upon release.

Hazardous Combustion Products: Not flammable; will not decompose.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Not flammable but containers may rupture violently in fire due to overpressurization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with excessively cold liquid argon, gas, or containment equipment. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Note that gas masks or cartridge type respirators will not function in oxygen depleted environments and may lead to suffocation.

FIRST AID

Nonspecific Symptoms: Symptoms of oxygen deficiency or frostbite.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration and get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove frozen clothing after thawing. Wash affected body areas with large amounts of water. Get medical attention immediately. Do not use hot water on or rub frostbitten areas.

1006

ARGON
Division 2.2 (Nonflammable Gas)

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid bodily contact with cold liquid or gas. Wear breathing apparatus and appropriate protective clothing where necessary. Move container from fire area if no risk. Be alert to container rupture potential due to overpressurization. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent entrapment of liquid in closed systems. Use oxygen monitoring equipment to test for oxygen deficient atmospheres where necessary. Vent argon to atmosphere slowly in well ventilated outdoor location if this method of disposal is selected. Since the boiling point of argon is somewhat less than that of oxygen, there is a possibility that cold liquid argon in exposed piping may cause some amount of oxygen in air to condense and liquefy. Consequently, it is best that any insulating materials used be compatible with oxygen if possible. Only metals and materials compatible with extremely low temperatures and/or high pressures should be used, thus excluding use of metals or other materials that may become brittle at the low temperatures that may be encountered. Take the heavier than air and potentially cold nature of argon into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Argon discharges may not generate hazardous airborne contaminant concentrations over significant distances in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the product is removed or depleted, particularly if less than bulk amounts have been released in outdoor locations.

CONSEQUENCE

Hazardous levels of argon in air may be found in the local spill area and immediately downwind.

MITIGATION

Restrict access to the local spill area and areas immediately downwind by unprotected personnel until flow is stopped or the container empties. Check for oxygen levels in air.

TECHNIQUE

EVACUATION . . . Where necessary due to the possibility of massive releases in populated areas, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ARGON
Division 2.2 (Nonflammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid argon, where necessary due to vulnerable surroundings, may be contained by building dikes or barriers using soil, sand or other materials. Note that any spilled liquid will boil vigorously at first and continue to vaporize rapidly.

TECHNIQUE

EXCAVATION . . . Where necessary, a trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Where necessary and possible, accumulated liquid pools may possibly be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks due to the high pressures and low temperatures that may be encountered.

MITIGATION

Use suitable equipment. Consider allowing liquid argon to boil or evaporate until naturally depleted or use a light water spray to accelerate boil-off.

WATER SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Any liquid argon contacting a water body will rapidly boil off. Traces of argon remaining in the water (if any) are completely harmless.

ARSENIC ACID, LIQUID

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Arsenic acid liquid, sometimes called orthoarsenic acid, is a pale yellow, green or transparent liquid which may be odorless, have a slight sweet odor or have an acrid odor. It is a toxic liquid with a boiling point of around 100 - 160ºF. It is a non-flammable liquid, but may react with metals to produce flammable hydrogen gas. It is used in the manufacture of arsenates, glass making, wood treating process, defoliant (regulated), dessicant for cotton and sterilant. It is completely soluble in water and heavier. Vapor density is unknown but may be heavier than air and may persist for a time in pits, hollows, and depressions. Containers of liquid may rupture violently and possibly explode if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 14.2 to 16.7 pounds per gallon.

Arsenic acid liquid is stable, however, excessive heat such as found in fire situations may make it unstable and it may generate toxic arsenical fumes. The product may react with many metals forming flammable hydrogen gas and basic materials to form arsenate salts. Reducing agents, alcohol, wood, turpentine, metal powders and hydrogen sulfide should also be avoided. Decomposition products may include arsenic pentoxide, arsenic trioxide and arsenates. Toxic arsine gas can be generated in the presence of aluminum and zinc reducing agents.

Product is highly toxic by all routes of exposure. Arsenic acid is a known carcinogen.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble.
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 1.713 - 2.0
Vapor Density: Unavailable
Boiling Point: Varies based on concentration; approximately 212 - 320ºF (100 - 160ºC)
Melting Point: Approximately 95ºF (35ºC)
Freezing Point: Unavailable
Molecular Weight: 141.94
Heat of Combustion: Not flammable
Evaporation Rate (butyl acetate=1): Unavailable, but one source reports it to be slower than ether.
Vapor Pressure: 17.5 mmHg at 68ºF (20ºC)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable Limits: Not flammable
pH: Weakly acid.
Stability: Stable; avoid heat.
Polymerization Potential: Will not occur.
Corrosiveness: Corrosive to tissues and metals.
Reactivity with Water: Not reactive.
Reactivity and Incompatibility: Reacts with steel, aluminum, zinc, galvanized metals and brass to evolve toxic arsine fumes. Reacts with basic materials to form arsenate salts. Avoid reducing agents, alkaline chemicals, alcohol, wood, turpentine, metal powders and hydrogen sulfide. Reaction with metals may produce flammable hydrogen gas.

IDENTIFICATION

Shipping Name(s): Arsenic acid, liquid (USDOT & IMO)
Synonyms and Tradenames: Orthoarsenic acid
CAS Registry No.: 7778-39-4
Chemical Formula: H_3AsO_4
Constituent Components (% each): Percentage of arsenic acid varies greatly, many solutions contain 2-5% nitric acid.
UN/NA Designation: UN1553
IMO Designation: 6.1, Toxic substances
RTECS Number: CG0700000
NFPA 704 Hazard Rating: 3(Health): 0(Flammability): 1(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Reports vary; pale yellow or green to a transparent liquid
Odor Characteristics: Reports vary; odorless, a light sweet odor or an acrid odor.
Reportable Quantity: See appendix I.
Common Uses: Manufacture of arsenates, glass making, wood treating process, defoliant (regulated), dessicant for cotton and sterilant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ARSENIC ACID, LIQUID

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Arsenic compounds are known human carcinogens and are highly toxic.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.2 mg/m^3 (ACGIH)

Ceiling (C) Limit: 0.002 mg/m^3 (NIOSH for arsenic solid)

IDLH: 5 mg/m^3

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Dangerous by all routes of exposure. The major hazard is from inhalation or ingestion.

Hazards of Skin or Eye Contact: Contact of liquid with the skin may be corrosive and may result in severe burns and tissue destruction. Contact with the eyes may be extremely irritating and corrosive and may result in burns.

Hazards of Inhalation: Inhalation is highly toxic and may cause intense irritation of the eyes, mucous membranes, and respiratory tract.

Hazards of Ingestion: Ingestion is highly toxic and may cause burns of the mouth, throat, and stomach.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Non-flammable liquid. May generate toxic arsenical fumes in fire situations. Concentrated material may be a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

Hazardous Combustion Products: Decomposition products may include arsenic pentoxide, arsenic trioxide and arsenates. Toxic arsine gas can be generated in the presence of aluminum and zinc reducing agents.

EXPLOSION HAZARDS

Explosive Potential: Concentrated material reacts explosively with combustible organic or readily oxidizable (especially if there is a nitric acid content) materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc. Reacts with most metals to release hydrogen gas which can form explosive mixtures with air.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with hazardous vapor or fume concentrations in air under accident conditions.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues and the respiratory tract; intense irritation of the eyes; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek medical attention immediately if skin irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

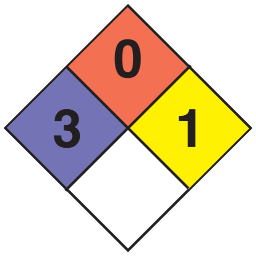
First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

1553

ARSENIC ACID, LIQUID

Division 6.1 (Poisonous Materials)



FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, water spray or foam.

Extinguishing Techniques: Unusual and toxic vapor hazard. Stay upwind. Avoid all bodily contact. Wear self-contained breathing apparatus. Wear full chemical protective suit if contact with material or fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture if exposed to fire conditions such as from a direct flame. Use water from a safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Take into consideration the highly toxic nature of arsenic acid while planning the response. Downwind evacuation should be considered. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Use intrinsically safe equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product, and which will not initiate a reaction. Take potential reactivity and high toxicity of arsenic acid into account when planning the response.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists, particularly if small amounts have spilled in cold weather.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind. Note that even very low concentrations may be irritating to the eyes and respiratory system.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Apply water at a point downwind. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

ARSENIC ACID, LIQUID
Division 6.1 (Poisonous Materials)

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts. Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid product may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Liquid product may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

ARSENIC ACID, LIQUID

Division 6.1 (Poisonous Materials)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with activated carbon, sand, or other nonreactive and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ARSENIC ACID, LIQUID

Division 6.1 (Poisonous Materials)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

ARSENIC TRICHLORIDE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Arsenic trichloride is a colorless or pale yellow or yellow-brown nonflammable fuming liquid with an acrid, pungent, and unpleasant odor. It is used in the ceramics industry and for making various arsenic compounds used in the manufacture of pharmaceuticals, insecticides, and other products. The substance reacts with water to form hydrogen chloride, hydrochloric acid, and arsenic compounds while generating heat, which also explains its fuming in moist air. The hydrochloric acid generated can react with most common metals to liberate flammable and potentially explosive hydrogen gas. Liquid arsenic trichloride itself weighs approximately 18 pounds per gallon.

Arsenic trichloride is stable in normal transportation, but besides reacting with water or moisture, is decomposed by ultraviolet light and certain active metals (which promote fuming) and may explode upon impact when mixed with certain other metals. It is highly toxic and corrosive by all routes of exposure and is considered to be a poison. Involvement in a fire may produce irritating and toxic fumes and vapors of hydrogen chloride, hydrochloric acid, and arsenic and its compounds.

Downwind evacuation should be considered when arsenic trichloride is leaking from its container until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Decomposes; see below

Solubility in Other Chemicals: Soluble in or solvent for hydrogen bromide or chloride, alcohol, chloroform, carbon tetrachloride, ether, iodine, phosphorus, sulfur, alkali iodides, and oils and fats.

Specific Gravity (Liquid): 2.16 at 68°F (20°C)

Boiling Point: 266.4°F (130.2°C) at 1 atm.

Melting Point: –0.4 to 16.7°F (–18 to –8.5°C); reported values vary.

Freezing Point: See melting point

Molecular Weight: 181.3

Heat of Combustion: Not flammable

Vapor Pressure: 10 mm Hg (0.193 psia) at 74.3°F (23.5°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Corrodes metal; stainless steel, coated steel, or polyethylene containers can be used for short term storage. Requires glass for long term storage.

Reactivity with Water: Reacts exothermically with water to form arsenic hydroxide ($As(OH)_3$) and hydrogen chloride (HCl) or hydrochloric acid fumes. Further dilution results in precipitation of arsenic trioxide (As_20_3).

Reactivity with Other Chemicals: Incompatible with reducing agents and active metals such as iron and zinc. Can explode upon impact when mixed with metallic sodium, potassium, or aluminum. Decomposes when exposed to ultraviolet light.

IDENTIFICATION

Shipping Names: Arsenic trichloride, (USDOT and IMO)

Synonyms and Tradenames: Arsenic (III) trichloride; arsenic chloride; arsenous chloride; arsenious chloride; caustic arsenic chloride; butter of arsenic; fuming liquid arsenic; caustic oil of arsenic.

Chemical Formula: $AsCl_3$

Constituent Components (% each): Unavailable; one maker states its product is more than 95% pure; another says 100%.

UN/NA Designation: UN1560

IMO Designation: 6.1, poisonous substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid (may solidify at low temperatures)

Color of the Shipped Material: Colorless or pale yellow or yellow-brown oily liquid.

Odor Characteristics: Acrid; unpleasant; pungent

Common Uses: Used in the ceramics industry, in making arsenic compounds containing chlorine, and in making organic arsenicals used in pharmaceuticals and insecticides.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ARSENIC TRICHLORIDE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic product that reacts with water or moisture in air to evolve hydrochloric acid fumes and vapors. Vapors and fumes generated when the product is involved in a fire may also contain highly toxic arsenic compounds. Any hydrochloric acid formed may react with metals to evolve flammable and potentially explosive hydrogen gas.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.2 mg/m^3 as Arsenic over each 8 hours of a 40 hour work week (ACGIH).

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the vapors or fumes of arsenic trichloride or its decomposition products that may be present in significant concentrations in air in the spill area and downwind. Direct contact and ingestion are also to be strictly avoided. There is evidence to suggest that inorganic arsenic compounds are skin and lung carcinogens in humans.

Hazards of Skin or Eye Contact: Contact of the skin with arsenic trichloride may cause local irritation, blisters, and severe burns, and the product may be rapidly absorbed through the skin in toxic amounts. Exposure of the eyes to vapors may cause spasm of the eyelids, tearing, pain, and reddening. Contact with the liquid may cause severe eye burns. Do not wear contact lenses when working with this product.

Hazards of Inhalation: Arsenic trichloride is poisonous if inhaled and causes irritation of the nose and throat. Symptoms of possible arsenic poisoning may be delayed. A concentration of 338 ppm was lethal to some mice after 10 minute exposures in laboratory experiments; cats died after one hour exposure to approximately 13.3 ppm (100 mg/m^3).

Hazards of Ingestion: Ingestion of arsenic trichloride causes severe irritation of the mouth and stomach. Symptoms of poisoning usually appear one-half to one hour after ingestion and include sweetish metallic taste, garlicky odor on the breath and stools, throat constriction, difficulty in swallowing, abdominal pain, vomiting, cold sweat, diarrhea, bluing of the skin, weak pulse, dizziness, headaches, coma, convulsions, and possibly death. The fatal human dose is 70–180 mg depending on the weight of the victim.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Non-flammable liquid. There is a rather limited possibility that containers may rupture violently in fire due to overpressurization. May generate large quantities of highly toxic and corrosive vapors and fumes upon release.

Hazardous Combustion Products: Not flammable but irritating and toxic hydrogen chloride and hydrochloric acid fumes and vapors and toxic fumes and vapors of arsenic and its compounds may form in fires.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

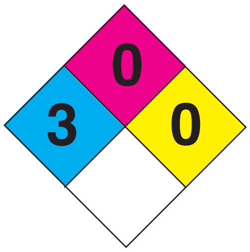
Upper Explosive Limit: Not flammable

Explosiveness: Mixtures with other substances such as sodium, potassium, or aluminum may explode upon impact. Contact of hydrochloric acid (formed in reactions with moisture or water) with most common metals produces hydrogen gas that may explode if ignited in confined spaces.

1560

ARSENIC TRICHLORIDE

Division 6.1 (Poisonous Material)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with arsenic trichloride. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. A maker of arsenic trichloride indicates that compatible materials may include polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid-type canister within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; symptoms of arsenic poisoning.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Although some authorities recommend induction of vomiting due to the high toxicity of arsenic, at least one recommends against it, probably due to the possibility of serious injury upon possible aspiration of acid into the lungs. Seek immediate medical advice on this issue if possible.)

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire. Note that arsenic trichloride reacts with water to produce hydrogen chloride and hydrochloric acid fumes but water spray or fog will help control these fumes.

Extinguishing Techniques: Toxic and corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes/smoke anticipated. Move container from fire area if no risk. Remove and isolate contaminated clothing at the site. Dike fire control water for later disposal. Do not scatter the material.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that some amounts of hydrogen gas may be liberated upon contact of hydrochloric acid with most common metals. Use explosion-proof and spark-proof equipment and tools where necessary. Take the reactive, highly toxic and corrosive nature of arsenic trichloride into account when planning the response.

ARSENIC TRICHLORIDE
Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Arsenic trichloride spills or fires involving this product may expose downwind areas to toxic concentrations over considerable distances if large quantities of vapors or fumes are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to arsenic trichloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain various hazardous chemicals from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to arsenic trichloride may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to arsenic trichloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Arsenic trichloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained arsenic trichloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

ARSENIC TRICHLORIDE

Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

ARSENIC TRICHLORIDE

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Where feasible and necessary, stream or lake beds may be dredged to remove heavier-than-water precipitates containing arsenic and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore as slurry.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage.

MITIGATION

Consult qualified experts for guidance.

March 1995

ARSENIC TRIOXIDE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Arsenic trioxide is a white powder that is usually considered to be odorless but may have a garlic-like odor. It is used for making lead-based alloys, rust inhibitors, preservatives, insecticides, herbicides, and a variety of other products. It is slightly soluble in water and considerably heavier so may be expected to sink and slowly dissolve. The product is not flammable and weighs approximately 231 pounds per cubic foot.

Arsenic trioxide does not react with water or common materials and is stable in normal transportation. It is incompatible with acids, sodium chlorate, mercury, and a variety of relatively unusual chemicals. The product is highly toxic by inhalation or ingestion and can be absorbed through the skin. In a fire situation, arsenic trioxide may emit highly toxic arsenic oxides or arsine upon decomposition.

If the material is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. If the material is on fire or involved in a fire, toxic combustion products may be formed; downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 1.82 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in hydrochloric acid, glycerol, and aqueous solutions of sodium hydroxide, sodium carbonate, and potassium hydroxide.

Specific Gravity (Solid): 3.7 at 68°F (20°C)

Boiling Point: Approx. 855°F (457°C) at 1 atm. (sublimes)

Melting Point: Approx. 599°F (315°C); some forms sublime

Freezing Point: Approx. 599°F (315°C); some forms sublime

Molecular Weight: 197.82

Heat of Combustion: Not flammable

Vapor Pressure: 1 mm Hg (0.019 psia) at 414.5°F (212 .5°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Corrosive to some metals (including copper and aluminum) in the presence of moisture.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with chlorine trifluoride, fluorine, hydrogen fluoride, oxygen difluoride, sodium chlorate, mercury, acids, water solutions of active metals, Rb_2C_2, zinc filings (may explode if heated), and aluminum.

IDENTIFICATION

Shipping Names: Arsenic trioxide, (USDOT and IMO);

Synonyms and Tradenames: Arsenous acid; arsenous acid anhydride; arsenous oxide; arsenic sesquioxide; white arsenic; arsenic oxide; arsenous anhydride; diarsenic trioxide; arsenious oxide; arsenic (III) oxide; arsenious trioxide; arsenite; arsenolite; crude arsenic; claudetite; arsodent.

Chemical Formula: As_20_3

Constituent Components(% each): crude 95%; refined, 98-99.999%; rest mostly Sb_20_3 and traces of other metals.

UN/NA Designation: UN1561

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Solid

Physical State as Released: Solid

Color of the Shipped Material: White

Odor Characteristics: Usually odorless but may have garlic-like odor

Common Uses: Mfg. of lead-based alloys, rust inhibitor, glass, wood and leather preservatives, paints insecticides, herbicides, rodenticides, other arsenic compounds, and textiles.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ARSENIC TRIOXIDE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Arsenic trioxide is highly toxic by ingestion or inhalation. It is suspected of being a carcinogen.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 0.2 mg/m^3 arsenic over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Entry into sewers or water; contact with incompatible materials; exposure of spilled product to heat or fire; inhalation of dust in air or fumes from material in fire; ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Arsenic trioxide is highly toxic by ingestion or inhalation. It is a recognized carcinogen of the lungs, liver, and skin and may also be carcinogenic to other organs.

Hazards of Skin or Eye Contact: Arsenic trioxide is capable of being absorbed through the skin in toxic amounts and of sensitizing the skin and causing inflammation. Prolonged eye contact may cause discomfort, edema of the lids, corneal injury and opacity.

Hazards of Inhalation: Breathing of arsenic trioxide dust may result in irritation of the stomach, intestine, and throat; diarrhea; anorexia; bloody stools or vomit; weak rapid pulse; cold sweats; liver damage; ulceration and perforation of the nasal septum; and coma. Large doses may be fatal.

Hazards of Ingestion: Ingestion may cause severe gastritis or gastroenteritis leading to collapse, shock, and death. Symptoms may include vomiting, headache, vertigo, muscle spasm, stupor, delirium, mania, and others. First symptoms may be delayed several minutes or even hours.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May emit highly toxic arsenic oxides or arsine upon decomposition in fire situation.

Hazardous Combustion Products: Decomposes to toxic arsenic oxides and/or arsine.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Generally not flammable or explosive.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, hood or hat, coveralls, and other impervious and resistant clothing for fine solids.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For low level exposures, a full or half mask respirator with replaceable dust or fume filter.

FIRST AID

Nonspecific symptoms:

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

1561

ARSENIC TRIOXIDE

Division 6.1 (Poisonous Material)

FIRE RESPONSE

Extinguishing Materials: Water, dry chemicals, carbon dioxide, foam, or dry ground dolomite for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible. that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Arsenic trioxide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of arsenic trioxide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access of unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid arsenic trioxide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose of or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to arsenic trioxide dust in air may reduce hazardous conditions.

CONSEQUENCE

Water runoff may contain varying amounts of arsenic trioxide.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Arsenic trioxide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Rain or other sources of liquid may permit arsenic trioxide to percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. If possible, protect arsenic trioxide from becoming wet.

ARSENIC TRIOXIDE

Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed with shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause toxic dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be diffcult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

ARSENIC TRIOXIDE

Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

Chemical treatment . . . Application of appropriate chemical agents to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some of the agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

September 2000

ASPHALT

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

The term asphalt is used to describe a number of dark brown to black liquids containing a complex mixture of heavy hydrocarbons, kerosene or other light oils, and various impurities. These thick semisolid liquids have a tarry or smoky odor and are used in paving or sealing road surfaces and as a base for various coatings and paints. They are generally considered insoluble in water and may either float or sink depending on specific composition. Flash points may vary from 50-550ºF and indicate that some products may be very difficult to ignite while others must be considered flammable liquids. It is noteworthy that some of the higher flash point liquids may be shipped in a heated condition and may therefore evolve flammable vapors when first spilled. Asphalt becomes molten at about 200°F. Under appropriate conditions, vapors may travel to a source of ignition. There is a limited potential for containers of more volatile grades to rupture violently if exposed to fire or excessive heat for sufficient time duration. Asphalts weigh approximately 6.7-10.0 pounds per gallon depending on composition with the lighter liquids usually the most flammable and fluid. Fire hazard is greater as liquid tenperature rises above 85°F.

Asphalts do not react with water but water or foam may cause frothing under fire conditions. They do not react with many other common substances and are primarily incompatible with strong oxidizing materials. Toxicity is generally low to moderate in acute exposures via the various potential routes of exposure. Products of combustion may include sulfides and other toxic gases.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Essentially insoluble, but a little will dissolve.
Solubility in Other Chemicals: Soluble in oil, benzene, turpentine, carbon disulfide, ether, trichloromethane, and other organic solvents.
Specific Gravity (Liquid): 0.8-1.2
Vapor Density: Unavailable
Boiling Point: Varies; Approximately 270 - 662ºF (132 - 350ºC) depending on grade.
Melting Point: Varies
Freezing Point: Varies
Molecular Weight: Varies
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): Unavailable
Vapor Pressure: Varies; Approximately 2 mmHg and maybe as high as 20 mmHg depending on grade
Flash Point: 50 - 550ºF (10 - 288ºC) depending on grade
Autoignition Temperature: 400 - 905ºF (204 - 485ºC) depending on grade
Burning Rate: Unavailable
Flammable Limits: 5% (LEL) - 20% (UEL)
Stability: Stable
Polymerization Potential: Will not occur.
Corrosiveness: Relatively noncorrosive.
Reactivity with Water: No reaction.
Reactivity and Incompatibility: Reacts with strong oxidizing materials.

IDENTIFICATION

Shipping Name(s): Asphalt (USDOT); Asphalt, cut backs (USDOT); Tars, liquid (USDOT & IMO)
Synonyms and Tradenames: Bitumen; Tar; Cut back asphalt; Asphaltic road materials; Petroleum pitch; Asphaltum; Judean pitch; Mineral pitch; Asphalt pavement surface sealer.
CAS Registry No.: 8052-42-4
Chemical Formula: Complex mixture
Constituent Components (% each): Complex mixture derived from petroleum or coal.
UN/NA Designation: UN1999; NA1999
IMO Designation: 3.2 or 3.3, Flammable liquids
RTECS Number: CI990000
NFPA 704 Hazard Rating: 0(Health): 3(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Dark brown to black
Odor Characteristics: Tarry, smoky
Reportable Quantity: See appendix I.
Common Uses: Paving or sealing road surfaces and roofs; base for sealers, paints, coatings, adhesives, and synthetic turf.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ASPHALT

Class 3 (Flammable Liquid) or Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Some constituents of fumes may be carcinogenic in long term exposures, particularly those from coal tars or pitch.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: 5 mg/m^3

IDLH: Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Potential Health Hazards: Major hazard is from prolonged inhalation of the concentrated fumes from hot asphalt. Direct contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Contact with hot asphalt may result in thermal burns of the skin or eyes. Prolonged contact at ambient temperatures may result in irritation or inflammation. Allergic skin reactions may occur on occasion and the skin may become sensitized to sunlight if the product is made from coal.

Hazards of Inhalation: Asphalt fumes are irritating to the eyes and the mucous membranes of the respiratory tract and may cause nausea, dizziness, and headache. The fumes of products made from coal are suspected of being carcinogenic in long term occupational exposures.

Hazards of Ingestion: Data unavailable. Ingestion is generally considered unlikely.

FIRE HAZARDS

Lower Flammable Limit: 5%

Upper Flammable Limit: 20%

Behavior in Fire: Some asphalts are flammable liquids that are easily ignited while others are difficult to ignite. Upon ignition, they burn with a bright flame. There is a limited potential for containers of some of the more volatile asphalts to rupture violently in fires. Application of water may cause frothing if the asphalt is very hot.

Hazardous Combustion Products: Hazardous combustion products include hydrogen sulfide, sulfur dioxide and other toxic gases.

EXPLOSION HAZARDS

Explosive Potential: There is a limited potential for containers of the more volatile asphalts to rupture violently in fires. Vapors from such products may explode if ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

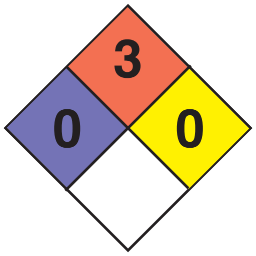
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices. (Note: The devices should also include a fume or high efficiency particulate filter.)

1999

ASPHALT

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; headache, nausea, or dizziness.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water or other appropriate cleanser. Get medical attention if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention if irritation persists after rinsing.

First Aid for Ingestion: If victim is conscious, administer water or milk. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam, water spray. Note that foam or water may cause frothing if asphalt is very hot.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources where necessary. Prevent flammable liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water or asphalt may result in damage to boilers or industrial process equipment. Use intrinsically safe equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that even small amounts of oils dissolving in water may cause odor, taste, and other problems. Some products may sink, some may float, and some may separate and do both. Take special precautions where flammable liquids are involved.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of chemicals in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to asphalt vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of asphalt from contact with airborne vapors or fumes and will accumulate in low lying areas.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Proceed with caution if asphalt is hot. Frothing may occur if water contacts the liquid.

ASPHALT
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of asphalt vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed cautiously if asphalt is hot and frothing may occur.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Asphalt may be confined by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Confined asphalt may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product. Hot liquids may solidify upon cooling and plug lines or equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Use judgment where spilled product may solidify upon cooling.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ASPHALT

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product. (Note: Use only for floating materials.)

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow. (Note: Use only for floating materials.)

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

ASPHALT

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating asphalt.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment if the asphalt has a low flash point.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with asphalt may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment if the asphalt has a low flash point.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONFINEMENT . . . Some asphalts will sink in water. Use natural deep-water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep-water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 2006

BENZENE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Benzene is a colorless, fairly volatile liquid with an aromatic odor resembling gasoline and is widely used in the United States. It is a component of motor fuel, has wide uses as a solvent, and is used to make detergents, explosives, dyes, plastics, pesticides, and other chemicals. It is only slightly soluble in water and lighter, so may be expected to form a floating surface slick. Its flash point of 12°F indicates that the product can be easily ignited under a wide range of ambient temperature conditions. Vapors of benzene may be heavier than air and may travel to a source of igniton and flash back. Accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.3 pounds per gallon.

Benzene does not react with water or many other common materials and is stable in normal transportation. It is, however, reactive with a variety of chemicals and can be expected to attack some forms of plastics, rubber and coatings. The product is generally considered to be of low to moderate toxicity in acute exposures, but long term occupational exposures are suspected to induce cancer. In the air, benzene reacts with other chemicals and breaks down within a few days, however, in water and soil breaks down more slowly. Products of combustion include carbon dioxide, carbon monoxide, irritating aldehydes and ketones.

If benzene is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.07%

Solubility in Other Chemicals: Soluble in acetone, alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether and ether.

Specific Gravity (Liquid): 0.88 at 68°F (20°C)

Vapor Density: 2.7

Boiling Point: 176.2°F (80.1°C)

Melting Point: 41.9°F (5.5°C)

Freezing Point: 41.9°F (5.5°C)

Molecular Weight: 78.12

Heat of Combustion: –9698 cal/g

Evaporation Rate (butyl acetate=1): Not available

Vapor Pressure: 75 mmHg at 68°F (20°C)

Flash Point: 12°F (–11.1°C), closed cup

Autoignition Temperature: 928°F (498°C)

Burning Rate: 6.0 mm/minute

Flammable (Explosive) Limits: 1.2% (LEL) – 7.1–7.8% (UEL)

Stability: Stable

Polymerization Potential: Will not occur

pH: Not applicable

Corrosiveness: May attack some forms of plastics, rubber and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with chlorine, oxygen, ozone, permanganates, many fluorides, nitric acid, sulfuric acid, peroxides, perchlorates, strong oxidizing agents, bromine with iron, and certain other chemicals.

IDENTIFICATION

Shipping Names: Benzene (USDOT & IMO)

Synonyms and Tradenames: Benzol; Phenyl hydride; Coal naphtha; Phene; Cyclohexatriene; Pyrobenzol; Pyrobenzole; Benzole; Annulene.

CAS Registry No.: 71-43-2

Chemical Formula: C_6H_6

Constituent Components(% each): 85% to more than 99% pure with remainder being toluene, xylene, and other substances.

UN/NA Designation: UN1114

IMO Designation: 3, flammable liquids

RTECS Number: CY1400000

NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 0 (Instability)

Physical State as Shipped: Liquid

Physical State as Released: Liquid (freezes below 42°F)

Color of the Shipped Material: Colorless to light yellow

Odor Characteristics: Pleasant aromatic; like gasoline

Reportable Quantity: See Appendix I

Common Uses: Component of motor fuels; solvent for paint remover and oils; mfg. of detergents, explosives, dyestuffs, plastics, pesticides, and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

BENZENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reported to be detectable at 2–5 ppm, caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back. Suspected to be a human carcinogen. Vapors may persist for a time in pits, hollows and depressions. There is the potential that flowing product may be ignited by self-generated static electricity.

Short Term Exposure Limits (STEL): Potential occupational carcinogen, 1 ppm (NIOSH); 5 ppm (OSHA)

Time Weighted Average (TLV-TWA): Potential occupational carcinogen, 0.1 ppm (NIOSH); 1 ppm (OSHA)

Ceiling (C) Limit: Unavailable

IDLH: Potential occupational carcinogen (500 ppm)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations in air that may be present but all exposures should be avoided due to the potential carcinogenicity of the product.

Hazards of Skin or Eye Contact: Benzene has a relatively strong irritating effect on the skin and may cause redness or blistering; prolonged or repeated contact may cause dry, scaly skin, possibility of secondary infection, and possibility of absorption through the skin in significant amounts. Contact with the eyes may cause primary irritation.

Hazards of Inhalation: Benzene vapors may irritate the skin and eyes. High concentrations may result in depression of the central nervous system with symptoms including euphoria, headache, dizziness, nausea, convulsions, coma, and possibly death.

Hazards of Ingestion: Ingestion may cause gastrointestinal irritation, nausea, diarrhea and vomiting. Aspiration into the lungs during vomiting or swallowing may result in pulmonary edema (possibly delayed) and lung hemorrhage.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 1.2%

Upper Flammable (Explosive) Limit: 7.8%

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable vapor upon release.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide, irritating aldehydes and ketones.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Certain reactions with incompatible materials may cause explosions.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

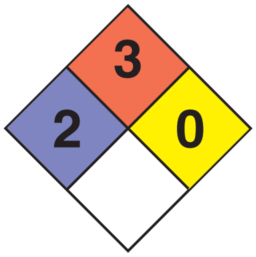
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 3; Tychem® CPF 4; Tychem® TK; Tychem® Responder®; Tychem® Responder® CSM; Tychem® F; Tychem® Reflector®; Tychem® ThermoPro; Barricade® coated suits; CPF3® suits; polyvinyl alcohol (gloves); Viton 890® gloves, 4H® and Silver Shield® brand gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Teflon® and Viton®. The following materials are ***not*** recommended for use: Tychem® CPF 2, Tychem® SL, neoprene, latex or rubber, butyl and nitrile latex.

Respiratory Protection: For unknown concentrations, fire fighting, or concentrations (above 0.1 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

1114

BENZENE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes or skin; central nervous system depression and other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of water until all traces of material are gone, at least 20 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water and administer large quantities of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Foam, dry chemical, carbon dioxide or water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Benzene may float on water. Do not use direct stream of water as product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable vapors. Note that benzene has a flash point of 12°F.

SPILL RESPONSES

General Information: Benzene is a highly flammable and volatile liquid that may cause environmental contamination even though it is expected to biodegrade to a moderate extent when released into the soil or water. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of benzene may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that benzene is a highly flammable substance that may evaporate rapidly and float on water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

BENZENE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Benzene may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of benzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to benzene vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. Benzene may float on water. Do not use direct stream of water as product may be carried across water surface spreading fire or carrying product to source of ignition. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain benzene from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of benzene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Benzene may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained benzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

BENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

BENZENE
Class 3 (Flammable Liquid)

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through the dam under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating benzene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with benzene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Note that only a negligible amount of benzene is expected to dissolve, therefore, this technique may not be needed. Should some benzene dissolve other techniques such as adsorption (activated charcoal) or aeration may be useful.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

March 1995

BENZOYL PEROXIDE

Division 5.2 (Organic Peroxide)

GENERAL INFORMATION

Benzoyl peroxide is a white granular crystalline solid that may be shipped as a paste or liquid mixture with water or other liquids to reduce its hazards. It is a highly flammable solid when dry that is either odorless or with a faint odor of benzaldehyde. The product is used as a bleaching agent for flour, fats, oils, and waxes; as a drying agent for oils and polymerization catalyst; and in making pharmaceuticals, cosmetics, rubber, acetate yarns, cheese, embossed vinyl flooring, and printing pastes and inks. It is slightly or sparingly soluble in water and heavier, so may be expected to sink and dissolve at a very slow rate. The product weighs approximately 83.2 pounds per cubic foot as a pure solid.

Benzoyl peroxide does not react with water. It is an extremely strong oxidizer, however, that is highly sensitive and may explode if exposed to shock, heat, or friction, and which may ignite or decompose violently at or above 176°F or 217°F (reported values vary). The product burns rapidly once ignited, strongly supports the combustion of other materials, and is difficult to extinguish. Contact with a variety of other chemicals and even ordinary combustible substances such as paper and wood may result in a fire or explosion. Various sources report that benzoyl peroxide should never be mixed unless at least 33% water is present while others note that mixtures with 30% or more water or unreactive organic solvents are substantially safer than the pure dry product. The toxicity of benzoyl peroxide is relatively low, but the substance can cause irritation by all routes of exposure. Products of combustion include "suffocating" dense white smoke containing benzoic acid, phenyl benzoate, terphenyls, biphenyls, benzene, and carbon monoxide. Corrosivity of the product is comparable to that of dilute hydrochloric or benzoic acids.

If a cargo of benzoyl peroxide is on fire or involved in a fire, evacuate for a radius of one-half mile for protection from the effects of potenial explosions. (Note: This guide discusses the properties and hazards of pure benzoyl peroxide except where noted otherwise.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; less than 1 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Said to be soluble in benzene, acetone, ether, chloroform, and nearly all other organic solvents, but note that benzoyl peroxide is a strong oxidizer.

Specific Gravity (Solid): 1.334 at 59°F (15°C)

Boiling Point: Ignites or decomposes explosively at or above 176°F (80°C) or 217°F (103°C); reported values vary.

Melting Point: See boiling point

Freezing Point: See boiling point

Molecular Weight: 242.2

Heat of Combustion: - 6406 cal/g

Vapor Pressure: 0.1 mm Hg (0.00193 psia) at 68°F (20°C)

Flash Point: Highly flammable solid when dry

Autoignition Temperature: See boiling point

Burning Rate: Not pertinent

Stability: See General Information section above.

Corrosiveness: Similar to that of dilute hydrochloric or benzoic acid.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Benzoyl peroxide is a strong oxidizer that may cause fires and or explosions in contact with ordinary combustible materials, including wood and paper, as well as some types of rubber, plastics and coatings, lithium aluminum hydride, methyl methacrylate, dimethylaniline, alcohols, amines, metallic naphenates, various acids, alkalies, and a wide variety of other easily oxidizable materials.

IDENTIFICATION

Shipping Names: Organic peroxide type B,C, D, or E, solid

Synonyms and Tradenames: Benzoic acid, peroxide; benzoyl superoxide; dibenzoyl peroxide; Dry and Clear; Epi-Clear; Lucidol; Oxylite; Panoxyl; Persadox; BPO; BP; Incidol; Acetoxyl; Acnegel; Benoxyl; and other trade names.

Chemical Formula: $(C_6H_5CO)_2O_2$ or $C_6H_5CO\text{-}OO\text{-}COC_6H_5$

Constituent Components (% each): 96-98% or more pure (dry, technically pure); also, various pastes or mixtures with water or liquid plasticizers such as tricresyl phosphate, silicone oil, or phthalate ester. Pastes or mixtures may pose less of a hazard.

UN/NA Designation: UN3102, UN3104, UN3106, UN 3107, UN3108, UN3109

IMO Designation: 5.2 organic peroxide

Physical State As Shipped: Solid, paste, or liquid mixture

Physical State As Released: Solid, paste, or liquid mixture

Color of the Shipped Material: White, granular, crystalline solid; may be in paste form or in liquid mixture when shipped.

Odor Characteristics: Odorless or having faint odor of benzaldehyde.

Common Uses: Bleaching agent for flour, fats, oils, and waxes; polymerization catalyst; drying agent for oils; pharmaceuticals and cosmetics; rubber vulcanization without sulfur; burn out agent for acetate yarns; making cheese; embossing vinyl flooring; printing pastes and inks.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

BENZOYL PEROXIDE

Division 5.2 (Organic Peroxide)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: May explode if subjected to heat, shock, or friction, particularly when dry. The material burns rapidly, is a strong oxidizer, and may cause fire or explosion upon contact with a wide variety of other substances.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average(TLV-TWA): 5 mg/m^3 over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Drying of wet peroxide; heat, fire, and sparks or static electricity of any kind; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: No systemic effects of toxicity have been reported in humans. Benzoyl peroxide is primarily an irritant of mucous membranes and may cause primary irritation and possibly sensitization dermatitis (an allergic reaction of the skin).

Hazards of Skin or Eye Contact: Contact of the skin with benzoyl peroxide may cause primary irritation. Prolonged contact may cause inflammation, while repeated contact may result in an allergic skin rash. In one set of experiments, the application of benzoyl peroxide to animal eyes caused superficial opacities in the cornea and inflammation of the conjunctiva. In other experiments, however, no injury resulted from single application of 93% pure powder or a 50% paste in dimethyl phthalate to rabbit eyes.

Hazards of Inhalation: The vapors and dust of benzoyl peroxide in air may cause irritation of the eyes, nose, throat, and skin. Workers exposed to a concentration of 12.2 mg/m^3 in air over an unspecified period of time experienced pronounced irritation. No specific systemic effects of exposure to humans have been reported, but one source lists decreased pulse and temperature, difficult breathing, and stupor as possible effects of overexposure.

Hazards of Ingestion: Benzoyl peroxide is of relatively low oral toxicity. No systemic effects of exposure to humans have been reported, but ingestion of large quantities has resulted in fatalities among animals in laboratory experiments.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Highly flammable solid and strong oxidizer. Burns rapidly. Strongly supports combustion of other materials. Difficult to extinguish once ignited. Prolonged exposure to fire or heat may cause containers to explode.

Hazardous Combustion Products: Decomposition produces suffocating dense white smoke containing benzoic acid, phenyl benzoate, terphenyls, biphenyls, benzene, CO and CO_2.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: The relatively pure peroxide is highly sensitive and may explode if exposed to shock, heat, or friction. Contact with a variety of other chemicals and even ordinary combustible materials may result in fire or explosion.

3102

BENZOYL PEROXIDE
Division 5.2 (Organic Peroxide)

See UN/NA Designation for
other ID numbers.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, aprons and other impervious and resistant clothing. Materials generally compatible with peroxides may include butyl, neoprene and nitrile rubber, polyurethane, polyvinyl chloride, and Viton. When handling the pure material, use clothing that is fire resistant and which does not generate static electricity. Conductive footwear should also be worn where necessary to prevent buildup of static electricity.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency particulate filter respirator with a full facepiece containing non-oxidizable sorbents (250 mg/m^3 or less); any fume or high efficiency particulate respirator or any dust and mist respirator (except single-use or quarter-mask units) containing non-oxidizable sorbents (50 mg/m^3 or less); or any dust and mist respirator (except single-use units) containing non-oxidizable sorbents (25 mg/m^3 or less). Note that some cartridges and canisters may contain activated charcoal, an oxidizable material, and should not be used.

FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray or fog. Large fires should be handled with large quantities of water.

Extinguishing Techniques: Dangerous explosion hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Be alert to potential explosion hazard if benzoyl peroxide has been subjected to heat, fire, or contamination. Do not move cargo or vehicle if cargo has been exposed to heat. If fire can be controlled, cool container with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible, withdraw from area and let fire burn. Note that the cargo will become more susceptible to ignition and decomposition or explosion as it dries out.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment. Take the flammability, explosivity, and reactivity characteristics of benzoyl peroxide into account when planning the response. Do not subject material to friction shock, heat, or contamination with other chemicals or combustible substances. Handle in as small quantities as possible. Prohibit heating facilities or electrical installations in storage areas. Ground all handling equipment; consider use of conductive flooring and personal protective equipment to reduce electrical spark ignition hazard. Do not load unload during electrical storms. Avoid all other sources of sparks or heat.

BENZOYL PEROXIDE
Division 5.2 (Organic Peroxide)

AIR SPILL

TECHNIQUE

WATER SPRAY . . . Benzoyl peroxide has a very low vapor pressure. For both fire prevention and dust suppression purposes, water spray can be applied as necessary to keep the spilled product wet.

CONSEQUENCE

Any water runoff may contain some amount of benzoyl peroxide.

MITIGATION

Contain spilled product and water runoff to prevent spread of contamination. Remove spilled product and other contaminated materials as soon as possible.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid benzoyl peroxide with a plastic sheet (polyethylene, e.g.) or other compatible material to prevent airborne dust. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated and pose a hazard.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly and carefully.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Solid benzoyl peroxide or pastes or liquid mixtures containing the product may be contained by building dikes using soil, sand, clay or other noncombustible materials.

CONSEQUENCE

Wetted pastes or liquid mixtures may percolate into soil or seep through dike materials. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with a compatible impervious material (polyethylene sheeting, e.g.).

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Where possible, line collection basin with compatible impervious material (polyethylene sheeting, e.g.).

TECHNIQUE

ABSORPTION . . . Wet spilled product down with water spray. Mix with wetted vermiculite, perlite, or other damp noncombustible inert material of weight at least equal to weight of spilled product. Sweep or scoop up and place in compatible plastic containers for immediate disposal.

CONSEQUENCE

Use of spark-generating metals or cellulosic materials such as paper, wood, straw, etc. for sweeping or handling spill material may result in fire or explosion under some conditions, particularly if the product is permitted to dry.

MITIGATION

Handle spilled materials only with noncombustible spark-proof materials and equipment. Use compatible plastic containers (polyethylene, e.g.).

BENZOYL PEROXIDE

Division 5.2 (Organic Peroxide)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Benzoyl peroxide will sink in water and dissolve very slowly, maintaining an equilibrium concentration in the water body.

Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, suitable hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Dredged or pumped materials brought to the surface and allowed to dry may pose a fire or explosion hazard. Equipment may become contaminated.

MITIGATION

Consult qualified experts for guidance. Keep the several hazardous properties of benzoyl peroxide in mind while implementing this response. Properly decontaminate all equipment after use. Store recovered materials in compatible plastic containers (polyethylene, e.g.).

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse.

Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

BENZOYL PEROXIDE

Division 5.2 (Organic Peroxide)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment. Any spilled product allowed to dry may pose a fire or explosion hazard.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary. Keep contaminated sorbent materials wet. Use compatible storage containers.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

BORON TRICHLORIDE
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Boron trichloride is a nonflammable colorless fuming liquid with a pungent, sharp, irritating, and acrid odor having a relatively low boiling point of 54.3 - 54.5°F. It is used to make boron fibers, semi-conductors, other chemicals and soldering fluxes, in the purification and treatment of various metals, and as an extinguishing agent for magnesium fires. The substance reacts vigorously with water to form hydrochloric and boric acids while generating heat, which also explains its fuming in moist air. The hydrochloric acid generated can react with most common metals to liberate flammable and potentially explosive hydrogen gas. Liquid boron trichloride itself weighs approximately 11.3 pounds per gallon. Due to its volatility, containers exposed to fire or excessive heat for sufficient time duration may rupture violently.

Boron trichloride is stable in normal transportation, but besides reacting with water or moisture, is also reactive with a variety of other materials. It is noncorrosive to metals when dry but may vigorously attack a variety of elastomers and packing materials. The hydrochloric acid produced in reactions with water, however, is corrosive to most metals, particularly to iron and aluminum, and may generate flammable and potentially explosive hydrogen gas during the corrosion process. Spills of boron trichloride may generate large quantities of heavier-than-air gases and fumes which are toxic and highly corrosive to bodily tissues. Any contact with the liquid may result in acid burns.

If boron trichloride is leaking and generating gases or fumes, downwind evacuation should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 1.35 at 59°F (15°C)
Boiling Point: 54.3 – 54.5°F (12.4 –12.5°C) at 1 atm.
Melting Point: –161.1°F (–107.3°C)
Freezing Point: See melting point
Molecular Weight: 117.2
Heat of Combustion: Not flammable
Vapor Pressure: 1.305 atm (19.17 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable in normal transportation
Corrosiveness: Noncorrosive to metals when dry but presence of moisture forms hydrochloric acid which is corrosive to many metals. Vigorously attacks many kinds of elastomers and packing materials.
Reactivity with Water: Reacts vigorously to form hydrochloric acid and boric acid while generating heat.
Reactivity with Other Chemicals: Reacts with aniline, nitrogen peroxide, phosphine, fat or grease, oxygen, organic matter, hexafluoroisopropylidene amino lithium, nitrogen dioxide, and alkaline materials.

IDENTIFICATION

Shipping Names: Boron trichloride (USDOT and IMO)
Synonyms and Tradenames: Trichloroborane; boron chloride
Chemical Formula: BCl_3
Constituent Components (% each): 99% or more pure; may contain small amounts of chlorine, phosgene, and silicon compounds.
UN/NA Designation: UN1741
IMO Designation: 2.2, nonflammable gas
Physical State As Shipped: Compressed liquefied gas (boils at 54.3 – 54.5°F)
Physical State As Released: Gas, liquid, or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent; choking, sharp; irritating; acrid
Common Uses: Catalyst for organic reactions; making of semi-conductors, other chemicals, and soldering fluxes; purification of metal alloys; treatment of aluminum; extinguishing agent for magnesium; and making of boron fibers.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

BORON TRICHLORIDE

Poison Gas
(Division 2.3)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly volatile, toxic, corrosive, and reactive substance which may generate large quantities of fumes and vapors upon release.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-C): Unavailable; but note that both boron tribromide and boron trifluoride are assigned 1 ppm absolute ceiling limits. (ACGIH)

Conditions to Avoid: Heat or fire; contact with moisture or incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentrations of vapors, gases, and fumes likely to be present in air in the spill area and over potentially considerable distances downwind. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Boron trichloride or excessive exposure to its fumes may cause skin irritation or burns with severe pain, redness, possible swelling, and rapid tissue destruction and scarring. Contact with the eyes may cause irritation, lesions, severe burns, and possible loss of vision. Do not wear contact lenses when working with this product.

Hazards of Inhalation: Fumes or gases evolved from boron trichloride may cause lung irritation, tearing of the eyes, coughing, excessive salivary and sputum formation, difficult breathing, pneumonitis, pulmonary edema, and possibly death. Note that pulmonary edema may be delayed in onset. Exposure to 20 ppm for 7 hours in contaminated cages was fatal to most rodents in laboratory experiments. All survived two 7-hour exposures at 50 ppm in cages cleaned every two hours but many succumbed at 100 ppm.

Hazards of Ingestion: Available data are limited. Expect severe burns of the mouth and stomach with possible severe consequences.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Non-flammable liquid that boils at 54.3 - 54.5°F. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of toxic and corrosive gases and fumes upon release.

Hazardous Combustion Products: Evolves toxic and corrosive fumes when heated to decomposition or in fires but is not itself flammable.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Containers may rupture violently in fire due to overpressurization. Contact of hydrochloric acid (formed in reactions with moisture or water) with most common metals produces hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with liquid boron trichloride. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1 ppm or so), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1741

BORON TRICHLORIDE

Poison Gas
(Division 2.3)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; coughing, choking, or other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Note that one authority indicates that adrenaline should not be used as a stimulant in cases of boron trichloride poisoning.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, or dry sand. Water spray or fog may be used on large fires with caution but try to avoid wetting of liquid boron trichloride since it may react vigorously or violently with water to produce acid fumes and heat.

Extinguishing Techniques: Toxic and corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Note that hydrogen gas may be liberated upon contact of hydrochloric acid with most common metals. Use explosion-proof and spark-proof equipment and tools where necessary. Take the volatile, corrosive, toxic, and reactive nature of boron trichloride into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Boron trichloride spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

BORON TRICHLORIDE
Poison Gas
(Division 2.3)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to boron trichloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point down wind in this response and do not allow it to contact liquid boron trichloride as this may increase vapor and fume evolution.

CONSEQUENCE

Water runoff may contain various acids from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid boron trichloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid boron trichloride may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid boron trichloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained boron trichloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

BORON TRICHLORIDE
Poison Gas
(Division 2.3)

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause
overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may
lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2006

BROMINE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Bromine is a dark red to reddish brown fuming liquid that is used in a variety of industrial processes and for making other chemicals. It is slightly soluble in water and is expected to sink in water and slowly dissolve. Its boiling point of 137.8°F and considerable vapor pressure indicate it will rapidly vaporize under high ambient temperature conditions, thus evolving relatively large amounts of vapors that are heavier than air and may accumulate and persist in low areas. Although bromine itself is nonflammable, it is a strong oxidizer that may cause fires or explosions in contact with common combustibles or other readily oxidizable materials. Containers may rupture if exposed to fire or excessive heat for sufficient time duration due to increasing pressure. Bromine weighs approximately 26 pounds per gallon.

Although stable in normal transportation, bromine reacts violently or explosively with a wide variety of materials including aluminum. Even a small amount of moisture can render it corrosive to other common metals. The product must be considered highly toxic by all routes of exposure. Excessive inhalation can cause severe injury or death and is a key hazard due to the high volatility of the material. Symptoms of exposure may be delayed.

If bromine is involved in an incident, as an immediate precautionary measure, isolate spill or leak area in all directions for at least 150 feet (50 meters) for liquids and at least 75 feet (25 meters) for solids. In the event bromine is released to the environment, consider the following evacuation distances. For **small** spills, isolate area for a radius of 200 feet (60 meters) in all directions with a downwind evacuation of 0.3 miles (0.5 kilometers) for daytime and 1.1 miles (1.8 kilometers) for nighttime. For **large** spills, isolate area for a radius of radius of 1100 feet (330 meters) in all directions with a downwind evacuation of 2.1 miles (3.3 kilometers) for daytime and 4.6 miles (7.3 kilometers) for nighttime. These distances should be adjusted when taking into consideration the amount of material spilled, location, local weather conditions and other factors. If a bulk container of bromine is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. Bromine is very toxic to humans, the environment and to aquatic organisms.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 3.6 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, carbon bisulfide, chloroform, carbon tetrachloride and ether.
Specific Gravity (Liquid): 3.12 at 68°F (20°C)
Vapor Density: 5.5
Boiling Point: 137.8°F (58.8°C) at 1 atm.
Melting Point: 19.0°F (–7.2°C)
Freezing Point: 19.0°F (–7.2°C)
Molecular Weight: 159.81
Heat of Combustion: Not flammable
Evaporation Rate (butyl acetate=1): Not available
Vapor Pressure: 173 mmHg (3.34 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable (Explosive) Limits: Not flammable
Stability: Stable
Polymerization Potential: One source reports that bromine undergoes violent polymerization in reaction with acrylonitrile.
Corrosiveness: Attacks most metals when moisture is present. Will corrode iron, steel, stainless steel and copper. Reacts with aluminum. Attacks most plastics that are not highly fluorinated.
Reactivity with Water: One source reports it may react with water producing corrosive hydrobromic acid and fumes of hydrogen bromide.
Reactivity and Incompatibility: Reacts with alcohols, aluminum, potassium, ferrous salts, mercury and its salts, aqueous ammonia and other alkali hydroxides, titanium, acetaldehyde, arsenates, ammonia, acetylene, acetone, acrylonitrile, calcium nitride, methyl alcohol, phosphorus, sodium, sodium carbide, tin, phosphorus oxide, and a wide variety of other substances. May cause ignition of ordinary combustibles and organic substances.

IDENTIFICATION

Shipping Name(s): Bromine or Bromine solutions (USDOT & IMO)
Synonyms and Tradenames: Molecular bromine
CAS Registry No.: 7726-95-6
Chemical Formula: Br_2
Constituent Components (% each): 99.8% or more pure with traces of chlorine, organic halogens, water, etc.
UN/NA Designation: UN1744
IMO Designation: 8, corrosive substances; 6.1, toxic substances
RTECS Number: EF9100000
NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 0 (Instability): Oxidizer
Physical Form as Shipped: Liquid (above 19°F)
Physical Form as Released: Liquid (above 19°F)
Color of the Shipped Material: Dark red or reddish brown
Odor Characteristics: Sharp, harsh, irritating, suffocating
Common Uses: Mfg. of pharmaceuticals, dyes, pesticides, fire retardents, germicides, water purifiers, other chemicals, perfumes, fumigants, bleaching agents, ethylene dibromide (fuel anti-knock agents), and military chemical agents. Also used for gold extraction.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

BROMINE

Class 8 (Corrosive Material)

and

and

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.05–3.5 ppm

Unusual Hazards: Highly volatile, reactive, and corrosive substance with heavier than air vapors. Contact with wood or other ordinary combustibles or organic substances can result in fire. Many reactions with other chemicals are violent or explosive. Extremely toxic to the environment and aquatic organisms.

Short Term Exposure Limits (STEL): 0.3 ppm (2 mg/m^3) (NIOSH)

Time Weighted Average (TWA): 0.1 ppm (0.7 mg/m^3) (NIOSH & OSHA)

Ceiling(C) Limit: Not Available

IDLH: 3 ppm

Conditions to Avoid: Contact with incompatible materials; runoff to water; any direct physical contact; inhalation of vapors; ingestion of liquid bromine or its solutions.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to highly corrosive vapors in air. Contact with liquid bromine may cause destructive burns. Bromine is also toxic by ingestion.

Hazards of Skin or Eye Contact: After mild cooling sensation at first, skin contact with liquid is highly corrosive and may cause skin discoloration, pain, serious burns, blistering and slow healing ulcers. Liquid bromine immediately affects eyes and may cause blurred vision, redness, pain, severe tissue burns and eye damage.

Hazards of Inhalation: Excessive inhalation of vapors may be very irritating and damaging to the respiratory tract and lungs. Symptoms may include headache, dizziness, cough, nosebleed, vertigo, pulmonary edema followed some hours later by abdominal pain, diarrhea and possibly a measles-like rash. Severe breathing difficulties involving pulmonary edema and pneumonia may be delayed complications. Overexposure may be lethal.

Hazards of Ingestion: Bromine should be considered a highly toxic poison. Ingestion may cause burns of the mouth, throat, and stomach. Symptoms may include sore throat, vomiting and abdominal spasms. One source reports the estimated lethal dose at l4 mg/kg.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Not flammable

Upper Flammable (Explosive) Limit: Not flammable

Behavior in Fire: Non-flammable liquid but will accelerate the burning of combustibles. Containers may rupture violently in fire due to over-pressurization. Will generate large quantities of toxic vapor or fumes upon release.

Hazardous Decomposition Products: Thermal decomposition products may include corrosive fumes of hydrogen bromide.

EXPLOSION HAZARDS

Explosive Potential: Not flammable but containers may rupture violently in fire due to overpressure. Contact with several other substances may result in formation of explosive mixtures (see Chemical/Physical Data section).

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include polyvinyl chloride and certain rubbers. Teflon® is reported to have a 4 hour breakthrough time.

1744

BROMINE

Class 8 (Corrosive Material)

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 3 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (3 ppm or less), the following styles of respiratory protection will work when equipped with a non oxidizable sorbent (not charcoal) and eye protection needed: any air-purifying full-facepiece respirator equipped with cartridge(s) providing protection against bromine; any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against bromine; any powered air-purifying respirator with a tight-fitting facepiece and cartridge(s) providing protection against bromine; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece. For lesser concentrations (2.5 ppm or less), the following styles of respiratory protection will work when equipped with a non oxidizable sorbent (not charcoal) and eye protection needed: any supplied-air respirator operated in a continuous-flow mode; or any powered air-purifying respirator with cartridge(s) providing protection against bromine. NOTE: For all respirators only nonoxidizable sorbents allowed (not charcoal).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin and respiratory tract.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of water until all traces of material are gone, or at least for 20 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

NOTE: Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, CO_2, alcohol-resistant foam or water spray. Do not use water stream.

Extinguishing Techniques: Toxic and corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the corrosiveness and reactivity of bromine with many common metals when deciding on the appropriate response and equipment. Note that bromine will sink in water and slowly dissolve. Take into account while planning the response that bromine is highly volatile and toxic with heavier than air vapors that may persist for a time in low areas. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust. Consult a qualified specialist on neutralization techniques; however, some sources suggest neutralizing small spills with sodium thiosulfate solution and releasing anhydrous ammonia gas, with caution and control, to neutralize bromine vapors in the air. (Do not use aqueous ammonia, because violent reactions with liquid bromine may occur.) Other sources suggest neutralizing liquid bromine with solutions of potassium carbonate, sodium carbonate or sodium bicarbonate. To help control vapor production, a thin layer of water can be applied over a pool of liquid bromine by using water spray or fogging techniques.

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of the material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

BROMINE

Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid bromine may eventually slow the release of vapors or fumes into the atmosphere. Some sources suggest neutralizing small spills with sodium thiosulfate solution and releasing anhydrous ammonia gas, with caution and control, to neutralize bromine vapors in the air. (Do not use aqueous ammonia, because violent reactions with liquid bromine may occur.) Other sources suggest neutralizing liquid bromine with solutions of potassium carbonate, sodium carbonate or sodium bicarbonate.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce additional hazards.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Bromine may be confined by building dikes using soil, sand or other non-combustible materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize confined product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

BROMINE
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes, motorized graders, scrapers, bulldozers and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may spread contaminate.

MITIGATION

Excavate as last resort, unless adverse environmental impacts can be minimized.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottoms sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

March 1995

BROMOACETONE
Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Bromoacetone is a colorless or violet liquid with a pungent odor that is usually shipped in lead-lined containers, cylinders, or bottles or cans packed in wooden boxes. It is used as a military tear gas and for riot control when dispersed in air and also for synthesis of organic chemicals. It is slightly soluble in water and heavier, so may be expected to sink and dissolve very slowly. Although information on specific flammability characteristics are unavailable, the product is designated by some authorities as a flammable liquid. Consequently, be advised of the possibility that accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. Cylinders of liquid may rupture violently and rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 13.6 pounds per gallon.

Information on whether bromoacetone reacts with water was unavailable but this is unlikely given its other properties. The liquid should be considered highly irritating and corrosive to the skin and eyes, potentially causing painful burns. Low concentrations of vapors in air are very irritating to the eyes, explaining use of the product as a tear gas, while higher concentrations or prolonged exposures to low concentrations can be highly toxic via inhalation. Products of combustion include highly toxic and irritating fumes containing bromine and bromine compounds.

If the material is leaking (not on fire), downwind evacuation of the immediate spill area should be considered on a case-by-case basis until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble
Solubility in Other Chemicals: Soluble in alcohol, acetone, benzene, and ether.
Specific Gravity (Liquid): Approximately 1.63
Boiling Point: 290°F (143.3°C); at 1 atm; reported to partially decompose.
Melting Point: – 65.2°F (– 54°C) or – 33.7°F (– 36.5°C); reported values vary.
Freezing Point: See melting point
Molecular Weight: 137.0
Heat of Combustion: Unavailable
Vapor Pressure: 9 mm Hg (0.174 psia) at 68°F (20°C)
Flash Point: Unavailable, but designated as flammable liquid
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Stable
Corrosiveness: Unavailable
Reactivity with Water: Unavailable, but not likely to be reactive.
Reactivity with Other Chemicals: Incompatible with oxidizing agents.

IDENTIFICATION

Shipping Names: Bromoacetone, liquid (USDOT); bromoacetone (IMO)
Synonyms and Tradenames: Bromo-2-propanone; acetonyl bromide; acetyl methyl bromide; 1-bromo-2-propanone.
Chemical Formula: CH_3COCH_2Br
Constituent Components (% each): Unavailable
UN/NA Designation: UN1569
IMO Designation: 6.1, poisonous substance
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless to pale yellow liquid when pure, but turns violet rapidly even in absence of air. Further decomposes to black resinous mass on long standing.
Odor Characteristics: Pungent
Common Uses: Military tear gas used in war and for riot control; also used in organic synthesis.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

BROMOACETONE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.5 mg/m^3 reported as recognition level in air.

Unusual Hazards: A highly poisonous and intensely irritating compound used as a tear gas when dispersed in air.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact of any kind with the liquid or its vapors.

HEALTH HAZARDS

Public Health Hazards: In the absence of specific details, and given the uses and classifications of this product, all exposures should be strictly avoided.

Hazards of Skin or Eye Contact: Bromoacetone is said to be intensely irritating and corrosive to the skin and eyes, causing painful burns, but more specific details are unavailable. The substance has been used as a tear gas and has caused permanent dense opacification of the cornea when splashed in the eye as a liquid. Only minor and temporary injury has resulted, however, from contact with a few fine droplets.

Hazards of Inhalation: Although symptoms of exposure are not specified, beyond the notation that excessive exposure may cause pulmonary edema (which is usually a delayed effect), various authorities consider bromoacetone vapors to be poisonous and intensely irritating to the eyes and respiratory system. A 10 minute exposure to 572 ppm in air is reported to have caused a human death.

Hazards of Ingestion: Specific data are unavailable, but note that bromoacetone is considered to be a poison.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquid. Containers may rupture violently in fire. May generate large quantities of flammable, toxic and irritating vapors upon release when heated.

Hazardous Combustion Products: Emits highly toxic and irritating fumes containing bromine and bromine compounds when heated to decomposition.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Designation as flammable liquid and vapor pressure of product suggests possibility that an explosion may result if vapors from warm liquid are ignited in a confined area. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: Self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). One authority suggests that the SCBA be approved for chemical warfare agents.

1569 BROMOACETONE

Division 6.1 (Poisonous Materials)

FIRST AID

Nonspecifc Symptoms: Excessive tearing of the eyes; other irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing and isolate them as necessary to prevent further exposures. Wash affected body areas with large amounts of soap and water until all traces of the chemical are removed. Get medical attention immediately if eye contact has occurred or skin irritation persists after washing.

First Aid for Ingestion: Data unavailable. Keep victim warm and at rest and seek immediate medical advice and attention.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray or fog.

Extinguishing Techniques: Unusual toxic gas or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or its fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Dike contaminated fire-control water for later disposal; do not scatter the material.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid all contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Bromoacetone may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if only small amounts have discharged.

CONSEQUENCE

Hazardous levels of bromoacetone in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access of unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Bromoacetone spills may expose downwind areas to toxic or irritating concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather or otherwise been vaporized.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

BROMOACETONE
Division 6.1 (Poisonous Materials)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to bromoacetone vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of bromoacetone from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that application of firefighting foam to the surface of liquid pools may slow the release of bromoacetone vapors into the atmosphere. Since foam is recommended for fire control purposes, it may also serve to reduce vapor evolution from such pools.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

COVERAGE WITH WATER . . . Application of a layer of water to the surface of contained liquid pools may possibly reduce emissions of vapors or fumes. Since bromoacetone is only slightly soluble in water and heavier, a layer of water applied as a light spray may serve to blanket the surface.

CONSEQUENCE

Addition of water will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Bromoacetone may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained bromoacetone may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

BROMOACETONE
Division 6.1 (Poisonous Materials)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, diatomaceus earth and sodium carbonate mixture, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water and dissolve very slowly. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

BROMOACETONE
Division 6.1 (Poisonous Materials)

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have acumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble iarge quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

BUTADIENE
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Butadiene is a colorless gas shipped under pressure as a liquid and having a mildly aromatic odor. It is used to make synthetic rubber, plastics, and other chemicals. Barely soluble in water and lighter, little of the product will dissolve before it boils or evaporates from the surface of a water body. Its very low flash point and its boiling point of 24.1°F indicate that the product may be easily ignited under all ambient temperature conditions and that large amounts of gas or vapor will be evolved from spills. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in low areas. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited and there is some known potential for explosions involving unconfined vapor clouds. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). Liquid butadiene weighs approximately 5.2 pounds per gallon.

Butadiene does not react with water or many common materials but does react with variety of other chemicals. The product is stable in normal transportation when shipped with an inhibitor, but prolonged exposure to air or exposure to excessive heat may initiate explosive self-polymerization in containers. Vapors of butadiene are of relatively low toxicity in acute exposures but contact with the liquid may result in frost bite. Products of combustion may include toxic constituents.

Downwind evacuation should be considered if butadiene is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.05 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and other organic solvents.
Specific Gravity (Liquid): 0.621 at 68°F (20°C)
Boiling Point: 24.1°F (–4.4°C) at 1 atm.
Melting Point: –164°F (–108.9°C)
Freezing Point: –164°F (–108.9°C)
Molecular Weight: 54.09
Heat of Combustion: –10560 cal/g
Vapor Pressure: 1.2 atm (17.6 psia) at 68°F (20°C)
Flash Point: –105°F (– 76.1°C) (est.)
Autoignition Temperature: 788 –842°F (420 –450°C)
Burning Rate: 8 mm/minute
Stability: Stable when inhibitors present in normal transportation. May polymerize under conditions described above.
Corrosiveness: Unsafe in acetylide forming materials like monel, copper, or copper alloys (forms explosive compounds).
Reactivity with Water: *No* reaction
Reactivity with Other Chemicals: Reacts with copper or its alloys, monel, strong oxidizers, phenols, crotonaldehyde, caustics, amines, alkanolamines, halogenated compounds, alcohols, glycols, glycol ethers, alkylene oxides, ammonia, halogens, ether, and acid anhydrides.

IDENTIFICATION

Shipping Names: Butadiene, inhibited (USDOT); butadiene (IMO)
Synonyms and Tradenames: 1,3-Butadiene; alpha-, gamma-, or trans-butadiene; biethylene; bivinyl; divinyl; buta-l,3-dime; erythrene; pyrrolylene; vinylethylene.
Chemical Formula: $CH_2 = CHCH = CH_2$
Constituent Components (% each): 98% or more pure with 0.01 –0.02% tert-butylcatechol as inhibitor.
49 STCC: 49 057 03; 49 057 04; 49 057 05
UN/NA Designation: UN1010
IMO Designation: 2.1, flammable gas
Physical State as Shipped: Liquefied compressed gas
Physical State as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Mildly aromatic
Common Uses: Mfg. of synthetic rubber, plastics, and organic chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

BUTADIENE
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.16 –0.17 ppm

Unusual Hazards: Extremely volatile and flammable substance. May violently polymerize if exposed to excessive heat or if peroxides form in presence of air and iron. Vapors are heavier than air, may travel a considerable distance to a source of ignition and may persist in pits, hollows, and depressions. Vapors are uninhibited and may form polymers that result in stoppage of vents or flame arrestors.

Short Term Exposure Limits (STEL): 1250 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): *1000* ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers; inhalation of vapor or direct physical contact with liquid.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of very high vapor concentrations that may be present in air and may persist in pits or depressions. Contact with the liquid is also to be avoided. The product is suspected of being carcinogenic in long-term exposures based on animal experiments.

Hazards of Skin or Eye Contact: Contact of liquid butadiene with the skin or eyes may result in irritation or a freezing burn due to frostbite. Delayed burns may result from the wearing of contaminated clothing.

Hazards of Inhalation: High levels of butadiene in air (8000 ppm) have been tolerated by humans for 8 hours with only slight irritation of the eyes and upper respiratory tract. Very high levels may be narcotic with symptoms including fatigue, headache, drowsiness, lightheadedness, unconsciousness, respiratory paralysis, and possibly death. Concentrated vapors may also cause asphyxiation via displacement of air.

Hazards of Ingestion: Ingestion of butadiene is unlikely but may result in frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 2%

Upper Flammable Limit: 11.5%

Behavior in Fire: Flammable compressed liquefied gas. Will generate large quantities of flammable gas upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire or heat may result in violent polymerization.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Loss of inhibitor or excessive heat may cause spontaneous violent polymerization resulting in container rupture. Contact with monel, copper, or copper alloys may result in formation of explosive mixtures. There is some known potential for explosions involving unconfined vapor clouds.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing providing protection from cold surfaces as well as from direct contact with the spilled product.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 20000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with front or back mounted canister *(*20000 ppm or less) providing protection against butadiene or a similar device with chin-style canister *(*5000 ppm or less) within the use limitations of these devices.

1010

BUTADIENE
Division 2.1 (Flammable Gas)

FIRST AID

Nonspecific symptoms: Irritation of the eyes or respiratory tract; other symptoms of inhalation or direct contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing. (Note: Do not use hot water for flushing. If clothing is frozen to skin, warm area in tepid water before removal.)

***First Aid for* Ingestion:** Give warm water to drink. Get medical attention.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective and may increase vapor evolution from liquid pools. `

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to liquid butadiene may vastly increase vapor evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled liquid. Eliminate ignition sources. Use explosion-proof equipment where necessary. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water, if appropriate. Note that intake of highly contaminated water may result in damage, rupture, or explosion of boilers or industrial process equipment under certain conditions. Note that piping carrying butadiene may be plugged by a rubbery polymer under appropriate conditions and that monel, copper, and copper alloy equipment such as brass should not be used. Take into account that butadiene is extremely volatile and flammable with heavier than air vapors that may persist in pits and depressions.

AIR SPILL .

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Butadiene spills may expose downwind areas to flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

BUTADIENE
Division 2.1 (Flammable Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to butadiene vapors or fumes may accelerate their dispersal in the atmosphere. Water should be applied at a point downwind of the spill and should not be permitted to contact liquid pools of butadiene as this may vastly increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of butadiene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of quiescent liquid pools may slow the release of butadiene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. Vapor evolution may temporarily increase when foam is added.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid butadiene may be contained by building dikes or barriers using soil, sand or other materials or by excavating a trench or ditch.

CONSEQUENCE

Contained butadiene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity..

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

BUTADIENE
Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination if significant amounts of butadiene may have dissolved in water. (Note: This is unlikely in many cases as butadiene will rapidly vaporize.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment techniques.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1991

BUTANE
Class 2.1 (Flammable Gas)

GENERAL INFORMATION

Butane, which may be also transported in the U.S. with the shipping name "liquefied petroleum gas", or LPG for short, is a colorless and flammable liquefied gas with a boiling point of approximately 31°F in the open environment. It may be odorless in air at low concentrations, have a mild petroleum-like odor, or possibly be treated with a foul (skunk-like) additive for leakage warning purposes. The substance is used as a fuel gas, solvent, refrigerant, aerosol propellant, and food additive. It is also used for making various organic chemicals, high octane liquid fuels, and synthetic rubber.

Butane is practically insoluble in water and lighter. Due to its relatively low boiling point temperature, any spilled liquid will boil or otherwise rapidly vaporize under all but the very coldest environmental conditions. Thus, spills have the potential to generate large amounts of vapor that may be heavier than air, may accumulate and persist in pits, hollows and depressions, and that may travel a considerable distance to a source of ignition and flash back or even explode. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5 pounds per gallon at its boiling point temperature.

Butane does not react with water or many other common materials and is primarily known to be incompatible with oxidizing materials that may cause its ignition. It is not corrosive to common metals but may attack some types of plastic and rubber. Toxicity of the product is low by all routes of exposure but contact with very cold liquid or gas may result in frostbite or freeze burns. Products of combustion may include toxic constituents.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if butane is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket. If a cylinder is so threatened, evacuate for a radius of one-third (1/3) mile. (Note: The data and information presented below are for pure n-butane. The properties of n-butane may be altered if it is shipped or stored as a mixture with other substances.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 30 ppm at 59°F (15°C)

Solubility in Other Chemicals: Soluble in alcohol, chloroform, ether, and many other hydrocarbons and their derivatives.

Specific Gravity (Liquid): 0.60 at 32°F (0°C); 0.579 at 68°F (20°C)

Boiling Point: 31.1°F (–0.50°C) at 1 atm.

Melting Point: *–217*°F (–138.4°C)

Freezing Point: See melting point

Molecular Weight: 58.12

Heat of Combustion: –10,840 cal/g

Vapor Pressure: Approx 2.05 atm (30.1 psia) at 68°F (20°C)

Flash Point: – 76°F (– 60°C), closed cup

Autoignition Temperature: 550 to 806°F (287.8 to 430°C); reported values vary in this range.

Burning Rate: 7.9 mm/minute

Stability: Stable

Corrosiveness: Not corrosive to common metals; may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react vigorously, ignite, or explode in contact with strong oxidizing agents or materials. Has potential to explode in the presence of nickel carbonyl and oxygen.

IDENTIFICATION

Shipping Names: Butane (USDOT and IMO); butane mixtures (IMO); liquefied petroleum gas (USDOT)

Synonyms and Tradenames: n-Butane; normal-butane; butyl hydride; diethyl; methylethylmethane; may be shipped in the U.S. as liquefied petroleum gas (LPG).

Chemical Formula: $CH_3CH_2CH_2CH_3$

Constituent Components (l each): Shipments of "butane" are likely to be 9410 or more pure with the remainder consisting of some amounts of isobutane, propane, pentanes, and similar hydrocarbons. Some grades may be less pure. Butane mixtures are likely to contain substances with generally similar hazards.

49 STCC: 49 057 06 (butane); 4905702 (butane, impure, for further refining); 4905752 (liquefied petroleum gas)

UN/NA Designation: UN1075 (USDOT for butane and LPG); UN1075 (IMO for LPG); UN1011 (USDOT & IMO for butane and butane mixtures)

IMO Designation: 2.1, flammable gas

Physical State As Shipped: Liquefied compressed gas

Physical State As Released: Boiling liquid, vaporizing liquid, gas, or mixture or gas and aerosols (small liquid droplets) depending on environmental and release conditions; the boiling point of the product is about 31.1°F.

Color of the Shipped Material: Colorless, but very cold gas may appear white at first due to condensation of water vapor in the atmosphere.

Odor Characteristics: Odorless or mild petroleum or gasoline odor; some shipments may contain a skunk-like odorant for leakage warning purposes.

Common Uses: Fuel gas; organic synthesis; raw material for synthetic rubber and high octane liquid fuels; solvent; refrigerant; aerosol propellant; food additive.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

BUTANE
Class 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Although one authority reports the odor of butane itself is recognizable at a 2582 ppm concentration in air, most sources indicate that its odor is not detectable in air below 5000 ppm. It may, however, be recognizable in water at levels on the order of 6 ppm according to some sources.

Unusual Hazards: Extremely flammable heavier than air gas or vapor may travel a considerable distance to a source of ignition and flash back. Vapors and gases may persist in pits, hollows, and depressions. Unconfined as well as confined vapor clouds may explode if ignited.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: 800 ppm over each 8 hours of a 40 hour work week (ACGIH TLV, 1990–91; OSHA PEL, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff of liquid to sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the very high concentrations of butane gas or vapor that may be present in air at the spill site and directly downwind. Direct contact with the liquid or very cold gas or equipment should also be avoided.

Hazards of Skin or Eye Contact: Contact with very cold liquid butane or concentrated gas streams may cause frostbite or freeze burns. Frostbite may also occur from contact with the surface of a very cold container of the product. One authority reports that liquid butane splashed in the eyes may cause stinging, watering, inflammation and cloudiness. Another reports that a spray of liquid butane into the eyes from a cigarette lighter only caused temporary blurring of vision in one reported incident.

Hazards of Inhalation: High concentrations of butane gas or vapor in air may cause central nervous system depression. For example, exposure to 10,000 ppm (1%) for 10 minutes is said to cause drowsiness. Very high concentrations of butane gas or vapor in air may cause suffocation by diluting the concentration of oxygen in air below levels necessary to fully support life. Progressively lower levels of available oxygen may produce dizziness, headache, nausea, errors in judgment, excitation, fatigue, accelerated pulse, gasping, confusion, vomiting, and loss of consciousness and death, possibly in seconds and without warning if oxygen levels drop too low. Experiments have also shown that butane may be a weak cardiac sensitizer that can cause abnormal heartbeats in animals under stress.

***Hazards of* Ingestion:** Due to its low boiling point temperature, ingestion of butane is unlikely. If it should occur, frostbite of the lips, mouth, and other contacted tissues may be possibly expected.

FIRE HAZARDS

Lower Flammable Limit: Most sources report 1.8 –1.9%; the NFPA says 1.6%

Upper Flammable Limit: 8.4 –8.5%

Behavior in Fire: Liquefied flammable gas. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently and possibly rocket in a fire.

Hazardous Combustion Products: Not well-defined; include carbon monoxide and carbon dioxide and possibly other toxic constituents. One authority reports that acrid smoke and fumes are generated upon thermal decomposition of butane.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently and possibly rocket in a fire. Explosion may result if vapors or gases are ignited in a confined area. There is known potential for explosions involving unconfined vapor clouds.

1011

BUTANE
Class 2.1 (Flammable Gas)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: *Equipment* should prevent any reasonable probability of eye contact with the spilled material and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, polyurethane, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Dizziness, drowsiness, or other symptoms of central nervous system depression or oxygen deficiency; frostbite or freeze burns of bodily tissues.

***First Aid for Inhalation*:** Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. Butane may be a weak cardiac sensitizer; it may not be prudent to administer epinephrine to the victim.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.)

First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.)

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or liquid or let fire burn if discharge is appreciable. Use carbon dioxide or dry chemical on small fires in the open involving smaller containers that can be safely extinguished and isolated from other flammables. Use water spray or foam on large fires to cool surroundings.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may rupture violently, suddenly release massive amounts of product and possibly rocket when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Note that contact with water may increase the rate of vapor evolution from any exposed pools of liquid butane.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the high volatility and flammable nature of butane into account while planning the response. Beware of possible heavy gas accumulations in low areas.

BUTANE
Class 2.1 (Flammable Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Butane discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases, particularly if the discharge is large.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to butane vapors or fumes in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid butane pools with water may increase vapor evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid butane.

TECHNIQUE

FOAM . . . There is a possibility that application of firefighting foam to the surface of liquid butane pools may slow the release of vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if any increases in vapor evolution may affect downwind populations or operational safety.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid butane may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Any remaining traces of butane on the ground will vaporize with time.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as nitrogen or carbon dioxide to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of the product into equipment.

WATER SPILL

Liquid butane will boil or rapidly vaporize from the water surface with negligible dissolution in the majority of cases.

January 1988

BUTYL ACETATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

This guide is for normar-butyl acetate, this being one of three isomers of butyl acetate with slightly different but mostly similar properties and hazards. The normal (n-) isomer is considered somewhat more irritating via inhalation than the sec- and tert-isomers. The sec-isomer is slightly more flammable than the others. Nevertheless, most of the information herein is generally applicable to all three isomers.

Butyl acetate (normal isomer) is a colorless liquid with an odor that is fruity and agreeable in low concentrations in air but not very pleasant at higher levels. It is used as a solvent in lacquers, leather and airplane dopes, perfumes, and other products. The liquid is slightly soluble in water and lighter, so may be expected to float while slowly dissolving. Its lowest reported flash point of 72°F (62°F for sec-) indicates that it may be easily ignited at warmer ambient temperatures. At or above such temperatures, vapors are somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.3 pounds per gallon.

Butyl acetate does not react with water or many other common materials and is stable in normal transportation. It is reactive with various chemicals, however, and will dissolve many plastics and resins. Toxicity is low to moderate via the various potential routes of exposure. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.68–1.0 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, benzene, and ether
Specific Gravity (Liquid): 0.875 at 68°F (20°C)
Boiling Point: 259°F (126°C) at 1 arm.
Melting Point: See freezing point
Freezing Point: –100°F (– 73.5°C)
Molecular Weight: 116.16
Heat of Combustion: – 7294 cal/g
Vapor Pressure: 10 mm Hg (0.193 psia) at 68°F (20°C)
Flash Point: 72–81°F (22.2–27.2°C), closed cup; 85–99°F (29.4–37.2°C), open cup.
Autoignition Temperature: 760–797°F (404–425°C)
Burning Rate: 4.4 mm/minute
Stability: Stable; hydrolyzes to acetic acid and n-butyl alcohol upon standing
Corrosiveness: Will dissolve many plastics and resins.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with nitrates, strong oxidizers, strong alkalis, and strong acids.

IDENTIFICATION

Shipping Names: Butyl acetate (USDOT); butyl acetates (IMO)
Synonyms and Tradenames: Acetic acid, butyl ester; butyl ethanoate; n-butyl acetate.
Chemical Formula: $CH_3C0_2(CH_2)_3CH_3$
Constituent Components(% each): Various grades, 90–99.5% pure
49 STCC: 49 091 28
UN/NA Designation: UN1123
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Pysical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Fruity and agreeable; disagreeable in higher concentrations
Common Uses: Solvent for lacquers, airplane dopes, paper coatings, perfumes, plastics, oils, rubber, leather coatings, other products; used in making safety glass, flavorings, adhesives, shoe polishes, and stain removers.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

BUTYL ACETATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.006–20 ppm; report values vary

Unusual Hazards: Flammable liquid. Not highly volatile but vapors may be heavier than air and travel to a source of ignition at warmer temperatures.

Short Term Exposure Limits (STEL): 200 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 150 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to the high vapor concentrations that may be present in air in the local spill area and immediately downwind.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid butyl acetate may cause dryness and irritation of the skin due to the mild defatting action of the product. Contact with the eyes may result in marked but temporary irritation.

Hazards of Inhalation: Vapors of butyl acetate are irritating to the eyes, nose, throat, and upper respiratory system at concentrations in air of 200–300 ppm or more. Higher concentrations are expected to cause narcosis and central nervous system depression with symptoms including headache, drowsiness, and nausea. Severe effects have followed exposure to 2000 ppm for one hour.

Hazards of Ingestion: Data unavailable. Product is of relatively low oral toxicity in animal experiments.

FIRE HAZARDS

Lower Flammable Limit: 1.38–1.7%

***Upper Flammable Limit*:** 7.6% (9.8% for sec- butyl acetate)

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. There is some limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

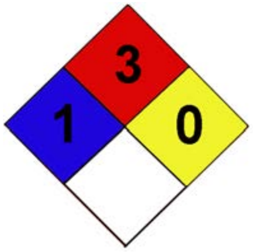
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include chlorinated polyethylene, polyurethane, polyvinyl alcohol, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 7500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (7500 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1123

BUTYL ACETATE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, respiratory system, or skin; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical (keep outside of tanks), various foams, water spray. (Note: Water may be ineffective on sec-isomer.)

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources as necessary. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of butyl acetate may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that butyl acetate is a flammable liquid that slowly dissolves in water.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Butyl acetate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of butyl acetate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to butyl acetate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of butyl acetate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

BUTYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

FOAM . . . Regular firefighting foam or alcohol foam applied to the surface of liquid pools may slow the release of butyl acetate vapors into the atmosphere. (Note: Alcohol foams are most effective.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Butyl acetate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained butyl acetate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE .

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

BUTYL ACETATE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating butyl acetate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

BUTYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with butyl acetate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

BUTYL ACRYLATE
Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Butyl acrylate is a clear colorless liquid with a sharp, biting characteristic odor. It is used for making paints, coatings, caulks, sealants, adhesives, other chemicals, and a variety of other products. The substance is very slightly soluble in water and somewhat lighter so may be expected to form a slowly dissolving surface slick. Its flash point of 105°F indicates that butyl acrylate must be moderately heated or exposed to high ambient temperatures before ignition may occur easily. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions if ignited. The product weighs approximately 7.5 pounds per gallon.

Butyl acrylate does not react with water or other common materials and is considered stable in normal transportation. Although shipped with an inhibitor, excessive heat as in a fire situation may cause self-polymerization resulting in violent rupture of the container. Self-polymerization may also be initiated by acids, alkalies, caustics, light, and other substances. Contact with explosives may cause an explosion. The product is moderately toxic and irritating via the various routes of exposure. Products of combustion may include toxic constituents.

If a container of butyl acrylate is exposed to direct flame or excessive heat, or if a fire becomes uncontrollable, evacuate for a radius of at least 1500 feet for protection from flying debris of the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.16 - 0.20 g/ 100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, and acetone.

Specific Gravity (Liquid): 0.90 at 68°F (20°C)

Boiling Point: 293 - 298.4°F (145 - 148°C) at 1 atm.

Melting Point: - 84.3°F (– 64.6°C)

Freezing Point: – 84.3°F (– 64.6°C)

Molecular Weight: 128.17

Heat of Combustion: – 7700 cal/g

Vapor Pressure: 3.3 - 4.0 mm Hg (0.064 - 0.077 psia) at 68°F (20°C)

Flash Point: 105°F (40.6°C), closed cup; 116 - 118°F (46.7 - 48°C), open cup.

Autoignition Temperature: 534 - 559°F (279 - 293°C)

Burning Rate: 4.7 mm/minute

Stability: Stable when inhibited in normal transportation. May polymerize under conditions described above.

Corrosiveness: Brass, bronze, or lead compounds not acceptable from a color and contamination standpoint.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with oxidizing agents, acids, alkalies, heat, sunlight, x-ray and ultraviolet radiation, azo and diazo compounds, hydrazines, caustics, cyanides, nitrides, organic peroxides and hydroperoxides, phenols and cresols, inorganic sulfides, dithiocarbamates, and alkali and alkaline earth metals.

IDENTIFICATION

Shipping Names: butylacrylate (USDOT and IMO)

Synonyms and Tradenames: n-butyl acrylate; butyl 2-propenoate; 2-propenoate; acrylic acid, butyl ester; 2-propenoic acid, butyl ester.

Chemical Formula: $CH_2{=}CHCOO(CH_2)_3CH_3$

Constituent Components(% each): 99+% pure with inhibitor such as methyl ether of hydroquinone (15 - 100 ppm) or hydroquinone (40-60ppm)

UN/NA Designation: UN2348

IMO Designation: 3.3, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sharp, biting, characteristic, acrylic odor

Common Uses: Resin and paint mfg; organic chemical mfg; emulsifier; polymers for solvent coatings, caulks, sealants, adhesives, and binders.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (202)483-7616 OR
THE AAR BUREAU OF EXPLOSIVES(202)639-2222

BUTYL ACRYLATE

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Excessive heat may cause self-polymerization with violent rupture of container. This may also be initiated by contamination with certain chemicals. Vapors are uninhibited and may form polymers in vents or flame arrestors, resulting in stoppage.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contamination by incompatible materials; runoff to sewers; water pollution; inhalation, physical contact, and ingestion.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to vapor in air. Additional hazards are posed by ingestion or physical contact with the product.

Hazards of Skin or Eye Contact: Prolonged contact of liquid butyl acrylate with the skin may result in moderate irritation and the liquid may be absorbed via the skin to a limited extent. Contact with the eyes may cause irritation and possible corneal damage.

Hazards of Inhalation: Breathing higher concentrations of acrylic monomers in air may cause salivation, eye irritation, and pronounced pulmonary irritation or edema.

Hazards of Ingestion: Ingestion of butyl acrylate may cause severe irritation of the mouth and digestive system. Ingestion of acrylic monomers in general may cause collapse, severe respiratory difficulties, and stimulation of the central nervous system.

FIRE HAZARDS

Lower Flammable Limit: 1.3-1.5%

Upper Flammable Limit: 9.4-9.9%

Behavior in Fire: Combustible liquid. Exposure of containers to fire may result in violent polymerization.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Loss of inhibitor or excessive heat or light may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in presence of acids, alkalies, caustics, and other substances.

PROTECTIVE CLOTHING AND EQUIPMENT

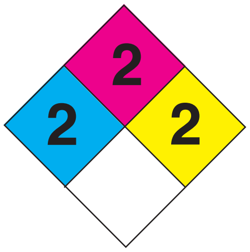
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials include (but are not limited to) neoprene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use of limitations of these devices.

2348

BUTYL ACRYLATE

Class 3 (Flammable Liquid) or Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of eyes, nose, mucous membranes, and/or skin depending on route of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer two glasses of water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, and possibly alcohol foam. Water spray may be effective on fires in open containers.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Avoid contact with spilled product. Prevent liquid from entering sewers and confined areas. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of butyl acrylate may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that butyl acrylate may polymerize under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Butyl acrylate may not evolve significant amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of butyl acrylate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to butyl acrylate vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of butyl acrylate from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

BUTYL ACRYLATE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FOAM ... Firefighting foam applied to the surface of liquid pools may slow the release of butyl acrylate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Butyl acrylate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained butyl acrylate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, fly ash, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

BUTYL ACRYLATE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS ... Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS ... Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

BUTYL ACRYLATE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

DIVERSION ... Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING ... Oil spill skimming devices may be deployed to recover floating butyl acrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION ... Straw, hay, peat, or commercial sorbent materials compatible with butyl acrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause over flow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

BUTYL ALCOHOL
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Butyl alcohol is a colorless liquid with a strong and pleasant, alcoholic, or pungent and camphor-like odor depending on the specific isomer of concern. Although this guide is primarily intended for the normal (n-) isomer, it is also mostly applicable to the sec- and tert-butyl alcohol isomers. Significant differences are highlighted below.

Although solubilities of the isomers vary, all are lighter than water and dissolve rapidly under most conditions. Flash points in the range of 52-84°F indicate that ignition may occur easily under a variety of ambient temperature conditions. In warm weather, vapors may travel a relatively short distance to a source of ignition and flash back, particularly if the more volatile tert-isomer has spilled. Accumulations of vapors in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The products weigh 6.5-6.8 pounds per gallon.

All of these alcohols are stable in normal transportation and do not react with water or many other common materials. They are incompatible with certain strong acids or oxidizers, however; will attack some forms of plastics, rubber, and coatings; and the normal isomer is known to react with aluminum at high temperatures. Toxicity is low to moderate via the various routes of exposure. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 7.7 g/100 g water (n-); 15.4 (sec-); fully soluble (tert-); all at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, and benzene.

Specific Gravity (Liquid): 0.81 at 68°F (20°C)

Boiling Point: 243.9°F (117.7°C)(n-); 211°F (99.5°C) (sec-); 181°F (82.6°C) (tert-); all at 1 atm.

Melting Point: See freezing point

Freezing Point: -129°F (-89.3°C)(n-); -174.5°F (-114.7#C)(sec); 78.3#F (25.7#C)(tert)

Molecular Weight: 74.12

Heat of Combustion: -7906 cal/g(n-); -8600(sec-); -7780 (tert-)

Vapor Pressure: 4.2 mm Hg (0.081 psia)(n-); 12.5 (0.242)(sec-); 31 (0.6) (tert-); all at 68°F (20°C)

Flash Point: 84°F (28.9°C)(n-); 75°F (23.9°C)(sec-); 52°F (11.1°C)(tert-); all closed cup

Autoignition Temperature: 650°F (343.3°C)(n-); 763°F (406.1°C)(sec-); 896°F (480°C)(tert-)

Burning Rate: 3.1-3.4 mm/minute

Stability: Stable

Corrosiveness: Attack some forms of plastics, rubber, and coatings. Normally reacts with aluminum at high temperatures; others may also.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: React with strong oxidizers and strong mineral acids; aluminum at high temperatures.

IDENTIFICATION

Shipping Names: Butanols (USDOT or IMO)

Synonyms and Tradenames: Normal is butanol, 1-butanol, 1-hydroxybutane, or n-propylcarbinol; sec- is 2-butanol, butylene hydrate, sec-butanol, 2-hydroxybutane, or methylethylcarbinol; tert is 2-methyl-2-propanol, tert-butanol, or trimethylcarbinol.

Chemical Formula: $C_4H_{10}O$

Constituent Components(% each): 99% or more pure

UN/NA Designation: UN1120

IMO Designation: 3.3 (n- and sec-) or 3.2 (tert); flammable liquids

Physical State as Shipped: Liquid

Physical State as Released: Liquid (tert freezes at 78.3°F)

Color of the Shipped Material: Colorless

Odor Characteristics: Strong, pungent, like alcohol, wine, or fuel oil (n-); strong, pleasant (sec-); pungent, like camphor (tert)

Common Uses: Many uses as solvents; mfg. of pharmaceuticals, other chemicals, artificial leather, safety glass, glues, shellac, raincoats, films, perfumes, and plastics.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

BUTYL ALCOHOL
Flammable Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 2.5-15 ppm (n-); 43 ppm (sec-); 73 ppm (tert-)

Unusual Hazards: Flammable alcohols of low to moderate volatility.

Short Term Exposure Limits(STEL): 150 ppm of sec- or tert- for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 100 ppm of sec- or tert- over each 8 hours of a 40 hour work week. Normal has 50 ppm absolute ceiling limit. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to high vapor concentrations in air as may occur near the spill and immediately downwind. Contact and ingestion should also be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact may result in drying and cracking of the skin due to the defatting action of these products. Contact with the eyes may cause mild to severe irritation with some chance of more severe injury.

Hazards of Inhalation: Vapors of butyl alcohols are irritating to the eyes, nose, and throat. High concentrations in air may cause narcosis and central nervous system depression with symptoms including headache, dizziness, drowsiness, and blurred vision.

Hazards of Ingestion: Data unavailable; expect irritation and some symptoms of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 1.4%(n-); 1.7%(sec-); 2.35%(tert-)

Upper Flammable Limit: 11.2%(n-); 9%(sec-); 8%(tert-)

Behavior in Fire: Flammable liquid. Vapors may travel to a source of ignition and flash back. There is some potential that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

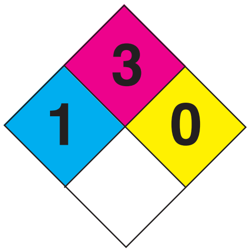
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials (for n-butyl alcohol) include butyl rubber, neoprene, nitrile rubber, polyethylene, chlorinated polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, viton, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 8000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (5000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1120

BUTYL ALCOHOL

Flammable Liquid



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, or skin; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after vomiting.

First Aid for Ingestion: If victim is conscious, induce vomiting. Do not make an unconscious persom vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol foam, water spray. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that butyl alcohols are flammable and that the tert isomer solidifies at temperatures below 78.3°F.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Butyl alcohol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of butyl alcohol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to butyl alcohol vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of butyl alcohol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rain water that may add to spill volume and overfill impoundments.

BUTYL ALCOHOL
Flammable Liquid

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid butyl alcohol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... Alcohol foam applied to the surface of liquid pools may slow the release of butyl alcohol vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short-term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Butyl alcohol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained butyl alcohol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

BUTYL ALCOHOL
Flammable Liquid

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the over all volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment techniques.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1991

BUTYLAMINE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

The shipping name "butylamine" is applied to a substance technically referred to as normal- or n-butylamine, a colorless, corrosive and flammable liquid with a fishy. and sour odor resembling ammonia. It is used for making a variety of products such as emulsifying agents, pharmaceuticals, insecticides, dyes, tanning agents, textiles, and rubber, among others. The product is fully soluble in water and will dissolve freely. Its low flash point indicates that it can be easily ignited under most ambient temperature conditions. Vapors may be heavier than air, may travel a considerable distance to a source of ignition and flash back, and/or may persist in pits, hollows, and depressions Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. Liquid n-butylamine weighs approximately 6.2 pounds per gallon.

n-Butylamine does not react with water or many other common materials and is stable in normal transportation. It is incompatible with acids and oxidizing agents, and as an aliphatic amine, is reactive with a variety of other chemical substances. Corrosive to several metals, the product also attacks some types of plastics and rubber and is extremely corrosive to all bodily tissues. Products of combustion include highly toxic oxides of nitrogen as well as other toxic constituents.

Besides n-butylamine, two other closely related substances may at times be referred to as "butylamine". These are isomers of the product and are technically and commonly referred to as secondary- or sec-butylamine, or tertiary- or tert-butylamine. Both are more volatile than n-butylamine and therefore pose potentially greater fire, explosion, and downwind toxic hazards, with the tertiary product being the most volatile.

If one of the butylamines of interest is leaking from its container but is not on fire, downwind evacuation or an alternative protective action should be considered based on the amount of material spilled, location, and weather conditions. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket. Note that the rupture hazard is greatest for tert-butylamine which is the most volatile of these butylamines.

CHEMICAL/PHYSICAL DATA

Solubility **in** ***Water:*** Soluble in all proportions

Solubility in Other Chemicals: The isomers may be soluble in many organic solvents including acetone, benzene, ethanol, ether, and others. Some authorities report that these substances may react violently with alcohols.

Specific Gravity (Liquid): 0.739–0.741 for n-butylamine; 0.720–.725 for sec-; 0.690–0.696 for tert-; all at 68°F (20°C)

Boiling Point: 170.6–172.4°F (77–78°C) for n-; 143.6–154.4°F (62–68°C) for sec-; 111.2–116.6°F (44–47°C) for tert-; all at 1 atm.

Melting Point: –58.9 to – 56.2°F (– 50.5 to – 49°C) for n-; –156.1 to –155.2°F (–104.5 to –104°C) for sec-; – 98.9 to – 88.6°F (– 72.7 to – 67°C) for tert

Freezing Point: See melting point

Molecular Weight: 73.14 or 73.16

Heat of Combustion: –9775 cal/g for n-; –9780 cal/g for sec-; –9790 cal/g for tert

Vapor Pressure: 68–82 mm Hg (1.314–1.585 psia) at 68°F (20°C) for n-; approx. 136 mm Hg (2.629 psia) at 68°F (20°C) for sec-; approx 225 mm Hg (4.349 psia) at 68°F (20°C) and approx 340 mm Hg (6.572 psia) at 77°F (25°C) for tert-; available data are limited and vary.

Flash Point: Reported values vary; most sources give 10°F (–12.2°C) on a closed-cup basis for n-butylamine, but 6°F and 26°F (–14.4°C and –3.33°C) are also reported; open-cup values range from 30°F to 45°F (–1.11° to 7.22 C). For the sec- isomer, most list a closed-cup value of 16°F (–8.9); the only open-cup value found was –9°F (–23°C). For the tert- isomer, sources give values ranging from less than –40°F (–40°C) to 16°F (–8.9°C) to 50°F (10°C).

Autoignition Temperature: 594°F (312°C) for n-; 712°F (378°C) for sec-; 707–716°F (375–380°C) for tert

Burning Rate: 5.79 mm/minute for n-butylamine; 6.18 mm/min for sec-; 7 mm/min for tert

Stability: Stable

Corrosiveness: n-Butylamine is reported to corrode metals such as aluminum, copper, copper alloys such as brass and bronze, zinc, zinc alloys, and galvanized surfaces in the presence of water; aqueous solutions are reported capable of attacking glass. All butylamines attack many forms of plastics and rubber.

Reactivity with Water: No reaction but heat is generated as butylamines dissolve in water. The resulting solutions are strongly alkaline; O.1M solutions are computed to have a pH of 11.8.

Reactivity with Other Chemicals: In general, contact of these butylamines with oxidizing agents are reported to potentially result in fire; reactions with acids may be violent and result in spattering; reactions with alcohols, glycol ethers, and monomers may be violent.

IDENTIFICATION

Shipping Names: Butylamine (USDOT); n-butylamine (IMO for normal isomer). Some shippers may use "flammable liquid, n.o.s." or "flammable liquid, poisonous, n.o.s."

Synonyms and Tradenames: 1-Aminobutane; 1-butanamine; butylamine; monobutylamine; mono-n-butylamine; MNBA; and normal-butylamine for n-butylamine.

Chemical Formula: $CH_3(CH_2)_3NH_2$ for the normal isomer; $CH_3CH_2CH(NH_2)CH_3$ for the sec- isomer; $(CH_3)_3CNH_2$ for the tert- isomer.

Constituent Components (% ***each):*** Limited data available; it appears that these products are available in purities ranging from 90010 up to about 100%.

49 STCC: 49 081 20 for n-butylamine; not established for sec-butylamine; 04909134 for tert-butylamine

UN/NA Designation: UN1125 (USDOT for "butylamine" and IMO for "n-butylamine"); UN1992 (USDOT for "flammable liquid poisonous, n.o.s." and also for similar IMO shipping name); UN1993 (USDOT for "flammable liquid, n.o.s." and also for similar IMO shipping name).

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Almost always liquid. Punctures into the vapor space of its containers under such conditions may discharge some amounts of pressurized gas.

Color of the Shipped Material: Colorless; solutions in water may be slightly yellow at times.

Odor Characteristics: Fishy; sour; like ammonia or amine

Common Uses: Making emulsifying agents, pharmaceuticals, insecticides, dyes, synthetic tanning agents, rubber and other polymers, antioxidants for gasoline, developing materials in photography, corrosion inhibitors for some metals, and desizing agents for textiles.

BUTYLAMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Values between 0.08 ppm and 125 ppm have been reported for the normal isomer. Most data suggest the odor is perceptible between 0.08 and 0.3 ppm in air, is considered slight at about 1 ppm and is noticeable at 1 to 2 ppm.

Unusual Hazards: Fairly volatile and corrosive flammable liquids with vapors that may be heavier than air at times and persist in low areas.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Ceiling (C) Limit: (Skin) 5 ppm absolute ceiling limit (ACGIH, 1990–91; OSHA, 1989) for normal isomer; not established for other isomers.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and over potentially considerable distances downwind. Direct physical contact and ingestion are also to be strictly avoided. Except where noted otherwise, the three butylamines of interest are presumed to pose comparable health hazards.

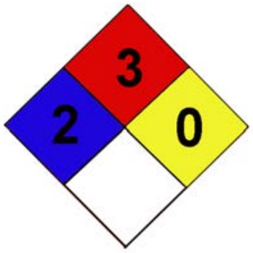
Hazards of Skin or Eye Contact: Undiluted liquid n-butylamine or 10% or 50% solutions of the product in water are expected to cause severe (second degree) skin burns and blisters with resultant death of skin tissue. The burns occur rapidly and are not greatly helped by prolonged washing, even if this occurs within 15 seconds of contact. Prolonged skin contact has the potential to result in absorption of toxic amounts of the liquid through the skin; symptoms such as headache, nausea, vomiting, faintness, anxiety and shock may occur due to subsequent effects on the nervous system. Experiments with animals suggest that skin absorption might be a greater hazard with n-butylamine than its other isomers. Vapors of volatile amines are generally known to cause eye irritation with lachyrmation, redness, and corneal edema (i.e., swelling). This can sometimes result in a temporary (day or so) and non-painful visual disturbance called "blue haze" or "halo vision" which occurs after about one to three hours of exposure to relatively low concentrations of vapors in air and causes foggy or blurred vision in which items appear blue-tinted and halos appear around lights. It is not specifically known whether butylamines can cause this effect but it is a distinct possibility. Contact of undiluted n-butylamine or 10% or 50% solutions of the product with the eyes can very rapidly cause burns that may result in serious permanent injury and possibly blindness. Contact lenses should not be worn when working with these chemicals. (Note: Repeated or prolonged skin contact with some amines can cause allergic skin sensitization; it is not known whether this may occur with the butylamines but it is a possibility.)

Hazards of Inhalation: Vapors of n-butylamine are irritating to the eyes, nose, throat, and lungs. Levels above permissible exposure limits are known to cause mild headaches and flushing of the skin and face. High levels in air may cause sore throat, nausea, vomiting, headache, faintness, coughing, chest pain, difficult breathing, anxiety, unconsciousness, and death. Non-lethal acute exposures may result in delayed pulmonary edema with possibly severe consequences, including death. n-Butylamine concentrations of 10 to 25 ppm are unpleasant and even intolerable to some people in exposures lasting more than a few minutes; all rats exposed to 3000 to 5000 ppm in laboratory experiments experienced an immediate irritant response, difficult breathing, pulmonary edema, and death within minutes to hours. A concentration of 1270 ppm of tert-butylamine was fatal to 50% of rats exposed for 4 hours. Note that the saturated vapors concentrations of n-, sec-, and tert-butylamine at 68°F are respectively and approximately 89,475 to 107,900 ppm, 178,950 ppm, and 296,050 ppm. In chronic exposure situations, airborne amines have been known to cause allergic respiratory system sensitization; it is not known whether butylamines can cause this response but it is a possibility.

***Hazards of* Ingestion:** Ingestion of n-butylamine may cause irritation and burns of the mouth, throat, and digestive tract. Symptoms may include headache, nausea, vomiting, faintness, anxiety, loss of coordination, sedation, nasal discharge, gasping, salivation, pulmonary edema, and eventually death. Due to the properties and effects of the product, it can be presumed that aspiration into the lungs during vomiting might also cause pulmonary edema with possibly severe consequences. The lowest reported oral LD$_{50}$'s, the doses found to be lethal to 50% of the animals, for n-, sec- and tert-butylamine were respectively 366 mg/kg, 152 mg/kg, and 44 mg/kg of body weight in experiments involving rats.

BUTYLAMINE

Class 3 (Flammable Liquid)



FIRE HAZARDS

Lower Flammable Limit: 1.7% for n- or sec-; 1.5% or 1.7% (at 212°F) for tert-butylamine
Upper Flammable Limit: 9.8% or 10% for n- or sec-; 8.9% (at 212°F) or 9.2% for tert-butylamine; reported values vary
Behavior in Fire: Flammable liquid. May generate significant quantities of flammable vapors upon release. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. There is some potential for containers to rupture violently and possibly rocket in a fire.
Hazardous Combustion Products: Carbon dioxide, carbon monoxide, various hydrocarbons, highly toxic oxides of nitrogen, and possibly some amounts of ammonia and other substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential for containers to rupture violently and possibly rocket in a fire. Reactions with certain other chemicals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof or vapor-tight safety goggles as appropriate, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases to prevent contact with high vapor or fume concentrations in air. Note that few materials have been confirmed as compatible with the butylamines of interest and several have been shown to be quickly attacked and destroyed (e.g., natural latex, neoprene, and disposable PVC) in limited experiments. It has only been reported with some certainty that Teflon may be resistant to n-butylamine and that at least one type of nitrite-butadiene rubber may resist breakthrough of tert-butylamine for more than one hour. Seek expert advice before using protective clothing under potentially dangerous circumstances involving direct contact with these butylamines.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 ppm) of nbutylamine, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister providing protection against butylamine (250 ppm or less) or a chemical cartridge respirator with a full facepiece providing protection against butylamine (250 ppm or less) within the use limitations of these devices. Canisters or cartridges should be of the ammonia/amine variety according to one maker of n-butylamine. Specific data are unavailable for other isomers. Use a SCBA as described above unless additional information becomes available for these materials from an expert or otherwise reliable source.

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues; headache, dizziness, coughing, nausea, difficult breathing, or other symptoms of exposure.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.
First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Keep victim warm and at rest. Get medical attention immediately. If vomiting occurs naturally or otherwise, have the victim lean forward and keep head below hips to reduce risk of aspiration of liquid into the lungs. NOTE: Some references, including a 1981 publication from NIOSH, suggest that an attempt be made to induce vomiting in conscious victims after water has been administered. Numerous others, however, including some recent publications from several major chemical companies, recommend that no attempt be made to induce vomiting. The problem is that induction of vomiting runs the risk of aspiration into the lungs and the development of pulmonary edema. Conversely, if medical attention is not immediately available, not inducing vomiting runs the risk of absorption of the chemical into the body and the development of the toxic effects discussed above, which also include pulmonary edema. Neither course of action is perfect, but it appears for the time being that professional opinions tilt towards diluting the chemical in the digestive tract and leaving it there until qualified medical attention is obtained. Seek the advice of a physician on this question immediately when possible if the need arises.

BUTYLAMINE
Class 3 (Flammable Liquid)

FIRE RESPONSE.

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear fully encapsulating protective suit where necessary if contact with concentrated vapors is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may rupture violently, possibly rocket, and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, it may be prudent to use unmanned hose holder or monitor nozzles. It this is impossible, it may also be prudent to withdraw and let fire burn, particularly if the more volatile isomers are involved. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take into account while planning the response that the butylamines of interest are highly corrosive to bodily tissues and are volatile flammable liquids with potentially heavier than air vapors that may persist in low areas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Butylamine discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to butylamine vapors in air may absorb some amount of the vapors and/or accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain butylamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of butylamine vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

BUTYLAMINE
Class 3 (Flammable Liquid)

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid butylamine may slow the release of vapors into the atmosphere. Use the coldest water available since heat will be generated upon mixing and this heat may actually increase vapor evolution for an initial period of time.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Proceed with caution where a temporary increase in vapor evolution may pose a threat to downwind populations or on operational safety. It may be best to truly flood" the area with water as rapidly as possible.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid butylamine may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained butylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite perlite, fly ash, cement powder, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of afire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

BUTYLAMINE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Butylamines will freely dissolve in water and form strongly alkaline solutions. These are known to be harmful to aquatic life in relatively low concentrations and may remain flammable until well diluted.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1997

BUTYLENE
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Butylene, also shipped as liquefied petroleum gas, is a colorless gas that is transported as a liquid under pressure and has a sweet and mildly aromatic odor. It is used for making a number of organic chemicals and is insoluble in water and lighter. With a flash point of -80°C (-112°F) and a boiling point of -6°C (21°F), and depending on the ambient temperature, there is a potential that large amounts of flammable gas will evolve from spills. The gas is heavier than air, may travel very considerable distances to a source of ignition and flash back, and may persist in pits, depressions and hallows. Accumulations of gas in confined spaces such as buildings or sewers may result in explosions if ignited, and there is also a possibility of explosions involving unconfined vapor clouds. Containers may rupture violently if exposed to prolonged fire or excessive heat. The liquid weighs approximately 5 pounds per gallon at ambient temperatures.

Butylene does not react with water or many common materials, but will react with oxidizers. It is stable in normal transportation. However, it is reactive with oxidizing materials and possibly other chemicals. The gas is not significantly toxic by inhalation, but high concentrations may be anesthetic or may cause asphyxiation via displacement of air. Liquid butylene and concentrated cold gas pose a frostbite hazard. Products of combustion may include toxic constituents.

Downwind evacuation should be considered if butylene is leaking but not on fire. If fire becomes uncontrollable or container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible
Solubility in Other Chemicals: Soluble in benzene, diethyl ether and ethanol.
Specific Gravity: .630
Vapor Density: 2.0 at 21°C (70°F)
Boiling Point: -6°C (21°F)
Melting Point: See freezing point
Freezing Point: -185°C (-301°F)
Molecular Weight: 56.11
Heat of Combustion: -10826 cal/g
Evaporation Rate: High
Vapor Pressure: 3257.00 mm Hg at 38°C (100°F)
Flash Point: -80°C (-112°F)
Autoignition Temperature: 385°C (725°F))
Burning Rate: 8.8 mm/minute
Flammable Limits: 1.6% (LEL) - 9.3 to 15% (UEL)
Stability: Stable
Polymerization Potential: Will not occur.
Corrosiveness: Not corrosive
Reactivity and Incompatibility: Oxidizers, halogens and acids.
Reactivity with Water: No reaction

IDENTIFICATION

Shipping Name(s): Butylene (USDOT & IMO); Liquefied petroleum gas (USDOT)
Synonyms and Tradenames: 1-Butene; Butene; alpha-Butylene; alpha-Butene; Ethylethylene
CAS Registry No: 25167-67-3
Chemical Formula: $CH_3CH_2CH=CH$
Constituent Components (% each): Mostly 1-Butene or Butene
UN/NA Designation: UN1012 (Butylene); UN1075 (Liquefied petroleum gas)
IMO Designation: 2.1
RTECS Number: EM2893000
NFPA 704 Hazard Rating: 1 (Health): 4 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Gas or liquid under pressure
Physical Form as Released: Gas or fuming liquid
Color of the Shipped Material: Colorless (gas may appear white at first)
Odor Characteristics: Sweet, mildly aromatic
Reportable Quantity: See appendix I
Common Uses: Mfg. of various organic chemicals, fuel, gasoline component, intermediate for polybutylenes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

BUTYLENE

Division 2.1 (Flammable Gas)

* Also 1075

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 69 ppb-12.5 ppm; reported values vary.

Unusual Hazards: Extremely volatile substance. Evolves large amounts of flammable heavier than air gas that may travel to a source of ignition and flash back. Gas may persist in low areas.

Short Term Exposure Limit (STEL): 1250 ppm for LPG for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 1000 ppm

Ceiling (C) Limit: Unavailable

IDLH: 2000 ppm for LPG (based on 10% of the LEL for safety considerations even though the relevant toxicological data indicates that irreversible health affects or impairment of escape exists only at higher concentrations).

Conditions to Avoid: Heat, fire and sparks; contact with incompatible materials; entry to sewers or confined spaces; inhalation; contact with cold product or equipment.

HEALTH HAZARDS

Potential Health Hazards: Major hazard is from inhalation of the high gas concentrations that may be present in the spill area and downwind. Contact with cold product may cause frostbite.

Hazards of Skin or Eye Contact: Contact with venting gas or liquid butylene may result in frostbite type burns.

Hazards of Inhalation: High concentrations of butylene gas in air may be anesthetic and may cause dizziness or unconsciousness. Very high concentrations may cause asphyxiation and death due to displacement of air.

Hazards of Ingestion: Ingestion is unlikely but may result in frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 1.6%

Upper Flammable Limit: 9.3-15%

Behavior in Fire: Material is extremely flammable. It will readily ignite if exposed to sources of heat and flame. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Containers exposed to prolonged heat or fire may rupture violently.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide. Runoff may be flammable and/or toxic.

Hazardous Combustion Products: Not well defined, may include toxic constituents.

EXPLOSION HAZARDS

Explosive Potential: High. Can readily form explosive mixtures with air. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. There is a possibility that unconfined gas clouds may also explode if ignited. Containers exposed to prolonged heat or fire may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Full fire retardant structural firefighting clothing meeting NFPA standards is recommended for handling spills when fire is the major concern.

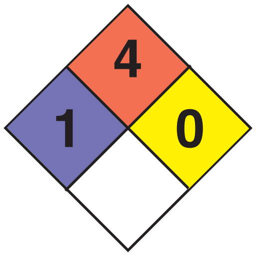
Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a positive-pressure, self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

1012

1075

BUTYLENE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Frostbite from contact; headache or dizziness from excessive inhalation.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact:Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. If burning or irritation persists after washing, provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Drink warm water to relieve frostbite, but do not induce vomiting without medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog) or foam.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases. Note that addition of water to liquid pools of butylene may increase gas evolution.

SPILL RESPONSES

General Information: Butylene is a highly flammable gas that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and storm drains. Runoff may be flammable and/or toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

BUTYLENE

Division 2.1 (Flammable Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Need to notify, organize, transport and house evacuees.

TECHNIQUE

MONITOR THE SITUATION . . . Butylene is expected to exist almost entirely in the vapor phase when released into the atmosphere. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Continue periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the generation of vapors.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

BUTYLENE
Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor for presence of flammable vapors. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor for presence of flammable vapors. Decontaminate equipment.

BUTYLENE

Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Booms may be an effective means to recover spilled material since the material is not water soluble and is lighter than water. Barriers of suitable material may be used to confine the spill to a limited area to prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions. Confined vapors will generate flammable vapors.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Continually monitor areas to identify hazardous areas.

TECHNIQUE

CONTAINMENT DIKES . . . If released into water sources, butylene should undergo volatilization. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION . . . Material is not water soluble. Overflow dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Some material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

SURFACE SKIMMING . . . Surface skimming may be effective since the material is not water soluble and is lighter than water.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

1,4-BUTYNEDIOL*

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

1,4-Butynediol is a colorless to pale yellow poisonous material with a musty odor which may be found as a crystalline solid or a liquid (aqueous solution). It is manufactured from the high-pressure synthesis of acetylene and formaldehyde. 1,4-Butynediol is used as a chemical intermediate, corrosion inhibitor, electroplating brightener, defoliant, stabilizer for chlorinated hydrocarbons, and as a cosolvent for paint and varnish removal.

1,4-Butynediol is extremely irritating to the eyes and skin. It may penetrate the skin and cause severe irritation and burns. The most common route of exposure is through skin contact. It is highly toxic by skin absorption, inhalation and ingestion. May cause irritation of the mouth and throat, nausea and vomiting, possibly leading to convulsions.

Although the fire potential for 1,4-butynediol is moderate, it will release ignitable vapors when heated. Polymerization will not occur. When heated to decomposition, the burning material may generate extremely acrid and irritating fumes. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for working in atmospheres where 1,4-butynediol is present. Runoff may be toxic. 1,4-Butynediol is water soluble. This material is normally stable, however it is incompatible with materials such as mercury salts and strong acids.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble.
Solubility in Other Chemicals: Alcohol, acetone and aqueous Acids.
Specific Gravity (Liquid): 1.1
Vapor Density (Air=1): 3.0
Boiling Point: 141°C (286°F)
Melting Point: 7°C (45°F)
Freezing Point: Unavailable.
Molecular Weight: 86.09
Heat of Combustion: Unavailable.
Vapor Pressure: 15 mm Hg at 142°C (288°F)
Flash Point: 128°C (263°F)
Autoignition Temperature: Unavailable.
Flammable Limits: 1.1% (LEL) - 3.0% (UEL)
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with mercury salts, strong acids, alkali earth hydroxides and halides at high temperatures.
Other Characteristics: When heated to decomposition, material emits acrid fumes.

IDENTIFICATION

Shipping Name(s): 1,4-Butynediol (USDOT & IMO)
Synonyms and Tradenames: 1,4-Dihydroxy-2-Butyne, 2-Butyne-1,4-Diol, 2-Butynediol, BIS (Hydroxymethyl) Acetylene, Butynediol, Butynediol-1,4, 1,4-Butindiol, 2-Butin-1,4-Diol and Butynediol Technical Flakes, CAS Registry No: 110-65-6
Chemical Formula: $HOCH_2CH:CHCH_2OH$
Molecular Formula: $C_4H_6O_2$
UN/NA Designation: UN2716
IMO Designation: 6.1
RTECS Number: NIOSH/ES0525000
OHMTADS Number: Unavailable.
NFPA 704 Hazard Rating: 2 (Health):1 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid (35% aqueous solution) / crystalline solid
Physical Form as Released: Liquid / crystalline solid
Color of the Shipped Material: Colorless to pale yellow
Odor Characteristics: Musty odor
Reportable Quantity: None established.
Common Uses: Product is used as a chemical intermediate, corrosion inhibitor, electroplating brightener, defoliant, stabilizer for chlorinated hydrocarbons and as a cosolvent for paint and varnish removal.

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*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1,4 BUTYNEDIOL

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: <1 ppm

Unusual Hazards: Material is immediately irritating to the eyes and skin.

Time Weighted Average (TLV-TWA): 1 ppm

Short Term Exposure Limit (STEL): 2 ppm

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, moisture, incompatible materials such as mercury salts, strong acids, acid fumes, alkali earth hydroxides, halides at high temperature, skin/eye contact, inhalation and ingestion. Material may not be stored near food stuffs.

HEALTH HAZARDS

Potential Health Effects: 1,4-Butynediol is severely irritating to the eyes and skin. May be fatal if absorbed through the skin or inhaled in toxic amounts. Material can penetrate skin and mucous membranes and cause burns. May cause severe allergic respiratory reaction. Gross overexposure may be fatal. Individuals with preexisting diseases of the cardiovascular system may have increased susceptibility to the toxicity of excessive exposures. Symptoms of exposure may be delayed.

Hazards of Skin and Eye Contact: Skin contact may cause skin irritation with rash, redness, swelling and dermatitis. Prolonged exposures may lead to skin burns or blistering and ulceration of soft tissue. Eye contact may cause irritation, tearing, or inflammation of conjunctiva.

Inhalation Hazards: Inhalation may cause central nervous system (CNS) effects such as nausea, headache, dizziness or general weakness. Irritation of the upper respiratory tract and wheezing may also occur.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, vomiting and convulsions.

FIRE HAZARDS

Lower Flammable Limit: 1.1%

Upper Flammable Limit: 3.0%

Behavior in Fire: Although 1,4-Butynediol will not readily ignite, it will burn if exposed to sources of heat and flame. Vapors may form explosive mixtures with air.

Hazardous Decomposition Products: When heated to decomposition, material releases acrid fumes. Toxic, irritating vapors may be liberated in fire situations.

EXPLOSION HAZARDS

Explosive Potential: Moderate, however containers exposed to heat and flame may explode and violently rupture.

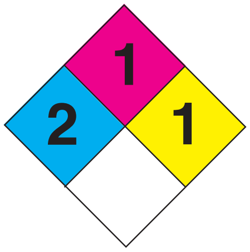
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Fully encapsulating, vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are neoprene. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits.

2716

1,4 BUTYNEDIOL
Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Direct skin contact can produce irritation, inflammation, redness and burns. Central nervous system (CNS) effects may include nausea, headache, dizziness or general weakness. The material is known to be a mucous membrane irritant. Other symptoms may include vertigo, dermatitis, arrhythmia and convulsions.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray, or alcohol-resistant foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water spray to cool fire-exposed containers, disperse vapors, and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may contain toxic concentrations of material.

SPILL RESPONSES

General Information: Secure potential sources of heat, sparks, flame, impact, friction, electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways and storm drains. Underflow dams are not an effective means to dike material since it mixes with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

1,4 BUTYNEDIOL

Division 6.1 (Poisonous Materials)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...If released into the atmosphere, 1,4-butynediol is expected to exist almost entirely in the vapor phase. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of combustible and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

FOAM...Alcohol-resistant foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways, and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

1,4 BUTYNEDIOL
Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material readily mixes with water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms are not an effective means to recover spilled material since the material is water soluble and heavier than water. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material is water soluble and the material does not float on the surface of the water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

1,4 BUTYNEDIOL

Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Cover solid form of material with a plastic sheet or other compatible material. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering sewers, waterways and storm drains. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

January 1988

BUTYRALDEHYDE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Butyraldehyde is a fairly volatile colorless liquid with a pungent, sweet and rancid odor. It is used in tanning and in making rubber, paper, plastics, dyes, drugs, and other chemicals. It is moderately soluble in water and lighter, so may be expected to form a floating surface slick that dissolves fairly rapidly. Its flash point of 15–20°F indicates that it can be easily ignited under a wide range of ambient temperature conditions. Vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs 6.7–6.8 pounds per gallon.

Butyraldehyde is stable in normal transportation and does not react with water or many other common materials. It reacts with various chemicals, however, and may self-polymerize violently in the presence of heat, acids, or alkalies. Products of combustion may include toxic constituents.

Downwind evacuation should be considered if butyraldehyde is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 7.1. g/100 g water at 77°F (25°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.803–0.8084 at 68°F (20°C)
Boiling Point: 167–168.3°F (74.8–75.7°C) at 1 atm.
Melting Point: –146.2°F (– 99°C)
Freezing Point: –142°F(–96.4°C)
Molecular Weight: 72.11
Heat of Combustion: –8450 cal/g
Vapor Pressure: 91.5 mm Hg (1.77 psia) at 68°F (20°C)
Flash Point: 20°F (6.7°C), closed cup; 15°F (– 9.4°C), open cup.
Autoignition Temperature: 446°F (230°C)
Burning Rate: 4.4 mm/minute
Stability: Stable, but readily oxidizes to butyric acid in presence of air. May polymerize under conditions described above.
Corrosiveness: Mild steel is corroded by butyric acid formed in presence of air.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with acids, alkalis, strong oxidizers, strong reducing agents, and possibly peroxides.

IDENTIFICATION

Shipping Names: Butyraldehyde (USDOT and IMO)
Synonyms and Tradenames: Butanal; butyric aldehyde; butyl aldehyde; butal; butaldehyde; butalyde; butyral; butyrylaldehyde. (Note: Any name may be preceded by n-.)
Chemical Formula: $CH_3CH_2CH_2CH0$
Constituent Components(% each): 97–99.5% pure with rest mostly water.
49 STCC: 49 081 19
UN/NA Designation: UN1129
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent and intense; sweet and rancid.
Common Uses: Tanning; mfg. of rubber, paper, plastics, dyes, drugs, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

BUTYRALDEHYDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.0046 ppm

Unusual Hazards: Volatile flammable liquid. May self-polymerize violently in the presence of heat, acids, or alkalis.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from high vapor concentrations that may evolve from a spill. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Contact of liquid butyraldehyde with the skin may result in irritation. Contact with the eyes may cause burns.

Hazards of Inhalation: Butyraldehyde vapors may cause coughing, watering of the eyes, irritation, nausea, vomiting, headache, and loss of consciousness as a result of central nervous system depression. A level of 200 ppm in air is the lowest causing observable toxic effects in acute exposures.

Hazards of Ingestion: Ingestion may cause severe damage to mucous membranes. The product is of low to moderate toxicity by this route of exposure.

FIRE HAZARDS

Lower Flammable Limit: 2.5%

Upper Flammable Limit: 10.6%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable vapor upon release.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Violent polymerization may occur in presence of heat, acids, or alkalis.

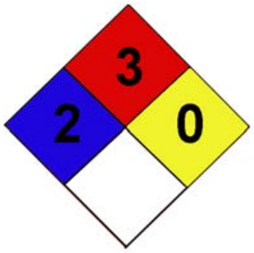
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, nitrile-butadiene rubber, and Buna-N.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1129

BUTYRALDEHYDE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, or skin; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol foam, water spray. Water may be ineffective but may possibly be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that fires are difficult to control due to ease of reignition.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that butyraldehyde is a relatively volatile flammable liquid with potentially toxic vapors. Note also that oil spill containment and cleanup methods are suggested by some sources for early stages of water spill response before the slick dissolves in water. Polymerization may occur under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Butyraldehyde spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

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BUTYRALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb butyraldehyde vapors and accelerate their dispersal in the atmosphere. the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of butyraldehyde from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of butyraldehyde vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . . Butyraldehyde can be contained by building dikes using earth, soil, or other materials.

CONSEQUENCE

Contained butyraldehyde may percolate into soil or seep through dike material. This may lead to loss of contained product and spreading of contamination. Groundwater contamination is also a possibility.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments, reinforce dike walls as needed.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product

BUTYRALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . . Spreading of butyraldehyde may be controlled by absorbing liquid with sand, earth, commercial sorbents and similar substances compatible with butyraldehyde.

CONSEQUENCE

Once needed; sorbent materials pose the same hazards as the spilled product. Although sorbents will immobilize the spill and help control spreading, they do not alter the hazardous nature of the spilled product. Their use adds to the volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

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BUTYRALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

CALCIUM CARBIDE

Division 4.3 (Dangerous When Wet)

GENERAL INFORMATION

Calcium carbide is a grayish to bluish black solid that has an odor somewhat resembling garlic. It is used to generate acetylene gas for welding; in the making of neoprene, vinyl acetate, lampblack, and various chemicals; and as a reducing agent. The substance decomposes immediately and vigorously upon contact with water or moisture to produce acetylene gas and calcium hydroxide (slaked lime). Acetylene is highly flammable and may ignite spontaneously. Accumulations of acetylene in confined spaces such as buildings or sewers may result in explosions. Calcium carbide weighs approximately 137.3 pounds per cubic foot.

Calcium carbide reacts with copper and brass to form an explosive compound, and is also reactive with acids (producing acetylene) and alkalis (producing acetylides). [Acetylene is a relatively non-toxic gas considered to be a simple asphyxiant. Lime can be irritating and somewhat corrosive to bodily tissues. Products of acetylene combustion are carbon monoxide, carbon dioxide, and water.]

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below. (Acetylene is 1173 ppm soluble at 77°F (25°C).)

Solubility in Other Chemicals: Data unavailable

Specific Gravity (Solid): 2.2 at 64.4°F (18°C)

Boiling Point: Not pertinent

Melting Point: 4172°F (2300°C) (approx.)

Freezing Point: See melting point

Molecular Weight: 64.10

Heat of Combustion: Not flammable (–11526 cal/g for acetylene)

Vapor Pressure: Not pertinent

Flash Point: Not flammable

Autoignition Temperature: Not flammable (581°F for acetylene)

Burning Rate: Not pertinent

Stability: Stable when dry.

Corrosiveness: Calcium hydroxide is mildly corrosive. Reacts with copper and brass.

Reactivity with Water: Reacts vigorously to form acetylene and calcium hydroxide (slaked lime).

Reactivity with Other Chemicals: Reacts with acids sulfur, magnesium, silver nitrate, selenium, lead fluoride, Na_20_2, and $SnCl_2$. Acetylene forms explosive compounds with copper and its compounds, brass, silver or mercury and their salts, halogens, nitric acid, sodium hydride, cobalt, potassium, rubidium hydride, and cesium hydride.

IDENTIFICATION

Shipping Names: Calcium carbide (USDOT and IMO)

Synonyms and Tradenames: Acetylenogen; calcium acetylide; calcium dicarbide; carbide; ethyne, calcium deriv.

Chemical Formula: CaC_2 (acetylene is C_2H_2; slaked lime is $Ca(OH)_2$)

Constituent Components(% each): 70-80% pure with 20-30% CaO (calcium oxide)

UN/NA Designation: UN1402

IMO Designation: 4.3, Dangerous When Wet

Physical State as Shipped: Solid

Physical State as Released: Solid

Color of the Shipped Material: Gray to bluish black

Odor Characteristics: Resembles garlic

Common Uses: Source of acetylene for welding; mfg. of neoprene, vinyl acetate, lampblack, graphite, and various chemicals; reducing agent.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

CALCIUM CARBIDE

Division 4.3 (Dangerous When Wet)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Vigorously reacts with water or acid to produce highly flammable acetylene gas that may ignite spontaneously.

Short Term Exposure Limits(STEL): Unavailable Time

Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Contact with water, acids, or other incompatible materials; entry to sewers or confined spaces where moisture may be present; inhalation of dust, ingestion, or direct physical contact; heat, fire, or sparks where acetylene may be present.

HEALTH HAZARDS

Public Health Hazards: Calcium carbide may be irritating and corrosive to bodily tissues.

Hazards of Skin or Eye Contact: Dry calcium carbide reacts with body moisture to form lime that may irritate or burn the skin or eyes.

Hazards of Inhalation: Breathing calcium carbide dust may cause coughing and irritation of the respiratory tract. Acetylene gas acts as a simple asphyxiant by diluting oxygen in air. Levels of 10% in air may cause slight intoxication.

Hazards of Ingestion: Ingestion of calcium carbide may result in irritation of the mouth and throat as well as the possible formation of ulcers on the lips.

FIRE HAZARDS

Lower Flammable Limit: Not flammable (2.5% for acetylene)

Upper Flammable Limit: Not flammable (80% for acetylene)

Behavior in Fire: Contact with firefighting water or foam generates flammable gas.

Hazardous Combustion Products: Carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Contact with water results in formation of flammable acetylene gas. Explosion may result if acetylene is ignited in a confined area. Contact with certain other materials may form explosive mixtures. (See Reactivity with Other Chemicals section.)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing.

Respiratory Protection:For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an approved dust respirator within the use limitations of such devices. (Note: Use SCBA where high acetylene concentrations may be present.)

1402

CALCIUM CARBIDE
Division 4.3 (Dangerous When Wet)

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues; headache, dizziness, incoordination, increased respiration, or other symptoms of narcosis or asphyxiation due to acetylene gas.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Symptomatic and supportive treatments as necessary. No permanent effects have been reported to date.

FIRE RESPONSE

Extinguishing Materials: Smother with suitable dry powder such as dry sand, graphite, soda ash, sodium chloride, lime, or let fire burn. Do not use water, foam or vaporizing liquids. CO_2 may be ineffective.

Extinguishing Techniques: Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing as necessary. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture, or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Keep calcium carbide as dry as possible to reduce fire, explosion, and other hazards. Note the potentially explosive reaction that may occur in the presence of copper or brass.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Calcium carbide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, especially if the calcium carbide is kept dry.

CONSEQUENCE

Hazardous levels of acetylene or calcium carbide dust may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid calcium carbide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

CALCIUM CARBIDE

Division 4.3 (Dangerous When Wet)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to acetylene gas in air may accelerate its dispersal in the atmosphere. Apply water at a point downwind and do not permit water to contact solid calcium carbide as this may increase evolution of acetylene.

CONSEQUENCE

Water runoff may contain a small amount (if any) of chemicals from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Calcium carbide or lime solutions may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained chemicals may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause calcium carbide dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generatlon. Do not operate motorized removal equipment where flammable gas concentrations may be present in air.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CALCIUM CARBIDE
Division 4.3 (Dangerous When Wet)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

CONTAINMENT . . . Lumps of product may sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit flammable vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

January 1990

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

GENERAL INFORMATION

Calcium hypochlorite, as discussed in this guide, is shipped as white powder, granules, flakes, pellets, or tablets having an odor like chlorine. Never truly pure, but usually mixed with a variety of other substances, the product is used as an algicide, bactericide, fungicide, deordorant, bleaching agent and oxidizing agent, but is probably best known for its use as the dry "chlorine" added to swimming pools for sanitation purposes. The solid is heavier than water and can be expected to sink, dissolve, and undergo a complex reaction described below. Powders, granules, and flakes will dissolve rapidly when spilled into large amounts of water. Some products, however, particularly those in the form of large pellets or tablets, are purposely formulated to dissolve slowly over a period of days. Calcium hypochlorite is stable in normal transportation when not exposed to heat, moisture, organic substances, or other incompatible substances. Exposure of calcium hypochlorite to prolonged heat may result in vigorous or violent decomposition of the product with the potential to rupture containers and possibly explode. Although calcium hypochlorite is not itself combustible, it is a strong oxidizing agent that will evolve oxygen and highly toxic chlorine and possibly chlorine monoxide gases at elevated temperatures while accelerating the burning of combustible materials. Contact with organic materials as well as a wide variety of other substances may result in fire or explosion. An explosion may result and chlorine gas may evolve upon contact of the product with acids or acid fumes. In the presence of moisture, calcium hypochlorite is corrosive to most metals, highly corrosive to bodily tissues, and again capable of evolving some amounts of chlorine gas. The solid product weighs approximately 146.6 pounds per cubic foot. Downwind evacuation should be considered until properly equipped responders have evaluated the hazard if spills of calcium hypochlorite evolve significant quantities of toxic chlorine gas due to circumstances of the event. If a bulk container of the product is exposed to high heat or a fire becomes uncontrollable, evacuate for a radius of one (1) mile.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very soluble; decomposes; some components of mixture may leave a residue.

Solubility in Other Chemicals: Unavailable Specific

Gravity (Solid): 2.35 at 68°F (20°C) for anhydrous; hydrate similar but varies.

Boiling Point: Decomposes above 212°F (100°C) or 350°F (177°C); reported values vary. Decomposition products include chlorine gas and oxygen.

Melting Point: See boiling point

Freezing Point: See boiling point

Molecular Weight: 142.99 for pure substance; hydrate varies with water content.

Heat of Combustion: Not flammable

Vapor Pressure: Unavailable

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable when dry and not exposed to heat or organic materials. Moderately explosive when heated in solid form. Traces of water may initiate the reaction.

Corrosiveness: Corrosive to most metals in presence of moisture.

Reactivity with Water: The reaction is complex. Calcium hypochlorite essentially forms weak hypochlorous acid in water which in turn primarily decomposes to chlorine, oxygen, and chloric acid in a reaction which is not hazardous in most cases when calcium hypochlorite is added to large amounts of water but may be hazardous under other circumstances. Reaction of the organic content of natural waters with hypochlorous acid and its products of decomposition forms chlorides. Water added to dry calcium hypochlorite may result in some evolution of chlorine gas.

Reactivity with Other Chemicals: Contact with organic substances of natural or synthetic origin (e.g., wood, straw, fuels, organic chemicals) may result in fire or explosion under a wide variety of circumstances. Emits highly toxic chlorine fumes and may explode on contact with acids or acid fumes. May explode in contact with amines, carbon tetrachloride, iron oxide (rust), manganese oxide, damp sulfur, urea, or mixture of sodium hydrogen sulfate, starch and sodium carbonate. Also incompatible with nitrogen containing compounds, dry chemical extinguishing agents containing ammonium compounds, and reducing agents. Hypochlorous acid may explode on contact with ammonia.

IDENTIFICATION

Shipping Names: Calcium hypochlorite, hydrated (USDOT and IMO); calcium hypochlorite mixture (USDOT); bleaching powder (USDOT and IMO); chlorinated lime (USDOT); chloride of lime (USDOT); calcium hypochlorite, hydrated mixtures (IMO); calcium hypochlorite, dry (IMO); calcium hypochlorite mixtures, dry (IMO)

Synonyms and Tradenames: Hypochlorous acid, calcium salt; calcium chlorohydrochlorite; calcium hypochloride; lime chloride; calcium oxychloride; and many tradenames such as HTH and Sentry for products used in swimming pools.

Chemical Formula: $Ca(C10)_2$ for anhydrous calcium hypochlorite

Constituent Components (% each): Commercial products contain various amounts of calcium hypochlorite in a mixture with sodium chloride, calcium chlorate, calcium chlorite, calcium oxychloride, calcium chloride, calcium hydroxide, and calcium carbonate.

49 STCC: 49 187 15 (dry, mixture, more than 39% available chlorine); 49 187 95 (hydrated, more than 39% available chlorine); 49 453 08 (powder, 39% or less available chlorine); 49 453 07 (powder or solution, 39% or less available chlorine); 49 323 32 (solution of chlorinated lime)

UN/NA Designation: UN1748 (dry or mixtures with more than 39% available chlorine); UN2880 (hydrated or hydrated mixtures); UN2208 (dry mixtures with 39% or less available chlorine)

IMO Designation: 5.1, oxidizer

Physical State As Shipped: Solid

Physical State As Released: Solid

Color of the Shipped Material: White powder, granules, flakes, pellets, or tablets.

Odor Characteristics: Like chlorine

Common Uses: Algicide; bactericide; fungicide; deordorant; bleaching agent; oxidizing agent; dry "chlorine" used in swimming pools.

**FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)**

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

See "UN/NA Designation" for more UN numbers

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** 0.02 – 3.5 ppm based on chlorine

Unusual Hazards: Highly reactive oxidizing agent. May cause ignition or explosion in contact with numerous combustible substances and other chemicals. May evolve chlorine gas upon heating and under various other spill conditions. Corrosive in presence of moisture.

Short Term Exposure Limits (STEL): 3 ppm for 15 minutes as chlorine gas in air. (ACGIH)

Time Weighted Average (TLV-TWA): 1 ppm over each 8 hours of a 40 hour work week as chlorine gas in air. (ACGIH)

Conditions to Avoid: Heat and fire; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact. Any action that may result in evolution of chlorine gas.

HEALTH HAZARDS

Public Health Hazards: Due to its highly corrosive nature to bodily tissues, all significant exposures to solid calcium hypochlorite should be avoided. Keep in mind, however, that this substance is a consumer product in widespread use by swimming pool owners and can be handled safely. It is only under unusual circumstances that a significant hazard may be encountered such as when large quantities of dust become airborne for one reason or another or when exposure of the product to heat or incompatible substances causes major evolution of chlorine gas into the atmosphere or a fire or explosion. See the Emergency Action Guide for chlorine for information where necessary.

Hazards of Skin or Eye Contact: Contact of calcium hypochlorite with the skin has the potential to cause severe irritation and/or burns with redness, swelling, and scab formation. Prolonged contact may impair regeneration of the skin at the site of contact. Contact with the eyes has the potential to cause severe irritation and/or burns as well as impairment of vision and corneal damage. If washed away promptly, however, particles in the eye will only cause minor and reversible injury in many cases.

Hazards of Inhalation: Calcium hypochlorite dust in air may be irritating to the eyes, nose, mouth, throat, and lungs. Inhalation of high concentrations may cause burns to the respiratory tract, laryngitis, and pulmonary edema which may possibly be delayed in onset and which may result in shortness of breath, wheezing, choking, chest pain, and impairment of lung function. Excessive exposures can result in permanent lung damage with possibly severe consequences. Based on the acute toxicity of chlorine, it has been estimated that exposure to 1700 mg/m^3 of calcium hypochlorite dust in air for one hour would be lethal to 50% of exposed rats.

***Hazards of* Ingestion:** Ingestion of a sufficient quantity of calcium hypochlorite may result in damage to the teeth as well as irritation and/or burns of the mouth, pharynx, esophagus, and the entire gastrointestinal tract including the stomach and intestines. Effects may include nausea, vomiting, diarrhea, abdominal pain, bleeding, edema and obstruction of the pharynx, glottis and larynx, circulatory collapse with cold and clammy skin, cyanosis, shallow respiration, confusion, delirium, coma, and perforation of the esophagus or stomach. Penetration of vital areas can result in peritonitis, mediastinitis, and death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable
Upper Flammable Limit: Not flammable

Behavior in Fire: Not combustible but may accelerate the burning of other materials by evolving oxygen at elevated temperatures. Exposure to prolonged heat may result in vigorous or violent decomposition with the potential to rupture containers. One authority reports that the bulk material may ignite or explode in storage and that traces of water may initiate the reaction.

Hazardous Combustion Products: Evolves chlorine, oxygen, and possibly chlorine monoxide at elevated temperatures. Reported data imply that decomposition begins at 212°F (100°C) and becomes rapidly exothermic at temperatures above 350°F (177°C).

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable
Upper Explosive Limit: Not flammable

Explosiveness: Contact with a wide variety of other chemicals may result in the formation of explosive mixtures. One authority reports that the bulk material may ignite or explode in storage and that traces of water may initiate the reaction. High temperatures may cause a rapid exothermic reaction that may possibly result in violent rupture of containers.

1748

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

See “UN/NA Designation” for more UN numbers

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing. Note that fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high concentrations of chlorine fumes or vapors in air where these may be generated in large quantities under accident or fire conditions. A manufacturer of calcium hypochlorite indicates that neoprene and polyvinyl chloride (PVC) may be compatible materials for handling the solid product. Compatible materials for chlorine may include neoprene, chlorinated polyethylene, PVC, Viton, and Saranex.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations of calcium hypochlorite dust in air (or levels of chlorine gas above 25 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For handling of solid under normal conditions, an approved respirator with a full facepiece, chlorine cartridges, and a dust/mist filter. For lesser concentrations of chlorine gas in air, a gas mask with chin-style or front or back mounted chlorine canister (25 ppm or less) or a chemical cartridge respirator with a full facepiece (25 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water is preferred, particularly for fires involving products containing more than 39% available chlorine. Do not use carbon tetrachloride (or other Halons to be safe) under any circumstances since an explosion may result. Similarly, do not use dry chemical agent containing monoammonium phosphate, which is also known as MAP, and is commonly found in dry chemical extinguishers having an ABC rating.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Where high concentrations of chlorine gas or fumes may be present, wear full chemical protective suit if contact with dense fumes or smoke is anticipated. Move container from fire area if no risk. Be alert to the possibility that containers may rupture violently when exposed to high heat. Stay away from ends of tanks or containers involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after the fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the corrosive and highly reactive nature of calcium hypochlorite into account while planning the response.

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow dusts, vapors, or fumes to dissipate. Calcium hypochlorite spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if conditions favor the evolution of large quantities of chlorine gas or fumes and/or the product is involved in a fire.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow dusts, vapors, and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Calcium hypochlorite may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the dry solid has spilled in a non-fire situation and is unlikely to encounter an incompatible substance.

CONSEQUENCE

Hazardous levels of calcium hypochlorite dust or chlorine gas in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid calcium hypochlorite with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to airborne vapors, fumes, or dusts evolved from calcium hypochlorite spills may absorb vapors, knockdown dusts or fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain various chemicals from contact with airborne vapors, dusts, or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Dry or wet calcium hypochlorite may be contained by building dikes or barriers using soil, sand or other compatible materials.

CONSEQUENCES

Contaminated liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may wet the spilled product or overfill impoundments. Where possible, line collection basins with compatible impervious material.

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify final remaining residues of the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for excessive chlorination. (Note: Solid calcium hypochlorite will sink to the bottom of the water body at first and undergo the complex reaction with water described above. Products of reaction are toxic to fish and other aquatic life at very low concentrations. The residue remaining after the reaction, especially in the case of granulated or powdered product, may later rise to the water surface for a time. The chlorine demand of natural waters, as well as exposure of the water to sunlight, is often sufficient to deplete the chlorine level of the water to safe levels after several days if not sooner.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CALCIUM HYPOCHLORITE
Division 5.1 (Oxidizer)

TECHNIQUE

CONTAINMENT DIKES... Water with dissolved chemical may be contained (or diverted to an impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: Under some spill conditions, it may be advisable to attempt to use natural deep water pockets, excavated lagoons, or sand bag barriers to trap the solid material on the bottom, particularly if the amount spilled is large compared to the volume of the water body or the product is intentionally formulated into relatively large and slow dissolving tablets or pellets.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries. Excavation of a deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental effects. Rapid reaction of the product with water, particularly if it is in granular, powder or flake form, may negate effectiveness of the latter response.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Excavate as a last resort.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments, particularly in cases where the calcium hypochlorite may have spilled under conditions in which it will not dissolve and react with water rapidly and time permits this response. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

August 1996

CAPROLACTAM*

Class 9 (Miscellaneous Hazardous Materials)

GENERAL INFORMATION

Caprolactam is a colorless to white solid that may be shipped as flakes, crystals, or another solid form. Alternatively, it may be shipped as a hot molten liquid at a temperature above the melting point of the material or in a solution with water or possibly another liquid. It is ranked among the top chemicals produced in the United States. Generally described as being odorless or having a mild odor, the substance is used in the making of a variety of products including synthetic fibers and leather, bristles, coatings, film, paints, and plastics. It is very soluble in water, has a low vapor pressure at ambient temperatures, a melting point in the range of 154°F to about 160°F, and a very high boiling point. The flash point of caprolactam is reported as 282°F. This indicates that the solid product will be difficult to ignite unless preheated or in the form of a powder or dust and that even the molten liquid may require substantial heating to attain its flash point temperature. Direct application of foam or water onto burning caprolactam may possibly result in frothing and spattering which may potentially be violent, yet use of these agents is among preferred methods of fire control or extinguishment. Solid caprolactam is reported to weigh about 68.6 pounds per cubic foot. The molten liquid weighs about 8.5 pounds per gallon at a temperature of 177°F, while a 70% solution in water weighs about 8.8 pounds per gallon at 77°F.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; 82 grams/l00 gal. water at 68°F (20°C) or 525 grams/l00 gal. water at 77°F (25°C). These data appear mutually inconsistent but nevertheless indicate a high degree of solubility.

Autoignition Temperature: 707°F (375°C)

Burning Rate: 2.4 mm/minute

Stability: Stable in normal transportation; may polymerize slowly and non-violently at temperatures at or above 212°F (l00°C).

Solubility in other Chemicals: Soluble in alcohols, benzene, chlorinated solvents, chloroform, dimethylformamide, ether, petroleum distillates, or cyclohexene.

Specific Gravity: 1.1 at 68°F (20°C) for solid; 1.02 at 171°F (77°C) for molten liquid; 1.05 at 77°F (25°C) for 70% solution in water.

Boiling Point: 515 - 518°F (268.3 - 270°C) at 1 atm for pure substance.

Melting Point: 154 - 159.8°F (68 - 71°C)

Molecular Weight: 113.16

Heat of Combustion: 7640 cal/gal.

Vapor Pressure: 0.001 mm Hg (0.00002 Pia) at 68°F (20°C)

Flash Point: 282°F (139°C) closed cup

Corrosiveness: Data unavailable; presumed to be compatible with most common metals. Based on chemical formula, presumed capable of attacking certain types of plastics, rubber, and coatings

Reactivity with Water: No reaction but the dry substance is hygroscopic and will therefore absorb some amount of moisture from the air if exposed to the atmosphere. See the Unusual Hazards section for phenomena associated with very hot molten caprolactam

Reactivity with other Chemicals: Reported as being incompatible with strong oxidizing materials which presumably have some potential to cause a vigorous reaction fire, and/or explosion upon mixture or contact with the product.

IDENTIFICATION

Shipping Names: Environmentally hazardous substance, N.O.S. or Other Regulated Materials N.O.S.

Synonyms and Tradenames: 6-Aminocaproic acid lactam; amino caproic lactam; 6-aminohexanoic acid cyclic lactam; 1-A.A.-2-cycloheptanone; 2-azacycloheptanone and e-caprolactam.

Chemical Formula: $HNCH_2(CH_2)_4CO$

Constituent Component (% each): Based on limited data, caprolactam appears to typically be 99% or more pure as a solid or molten liquid product in commerce.

UN/NA Designation: UN3082 or NA3082

IMO Designation: Class 9

Physical State As Shipped: Flakes or crystals. Hot molten liquid at or above the melting point temperature of caprolactam, or a solution in water. (Note: Solutions in liquids other than water are not addressed in this Guide.)

Physical State As Released: Same as shipped; molten liquid will solidify as it cools down.

Color of the Shipped Material: Colorless or white solid. Clear colorless molten liquid. Aqueous solutions are presumed to be colorless.

Odor Characteristics: Odorless or mild

Common Uses: Making of synthetic fibers such as nylon 6; making of amino acid lysine bristles, coatings, film, plastics, plasticizers, polyurethanes, and synthetic leather.

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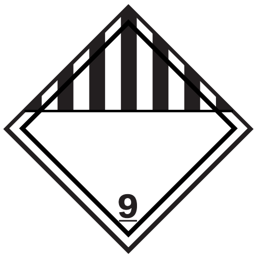
*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CAPROLACTAM

Class 9 (Miscellaneous Hazardous Materials)



POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold odor Concentration: 0.063 ppm (equivalent to 0.3 mg/m^3) is only available value.

Unusual Hazards: By analogy to other substances, there is a possibility that pressure relief devices (if any) on tanks of the molten liquid may be susceptible to plugging with solid and subsequent malfunction. Introduction of water or another volatile liquid into very hot molten caprolactam or hot tanks may potentially cause violent steam generation leading to tank rupture or personnel burns when temperatures are sufficiently above 212°F. Caprolactam may remain molten under a solid crust for extended periods; check carefully before walking on such crusts.

Short Term Exposure Limit (STEL): 10 ppm for vapor (3 mg/m^3 for dust) for 15 minutes (ACGIH, 1991-92; OSHA, 1989).

Time Weighted Average (TWA) Limit: 5 ppm for vapor (1 mg/m^3 for dust) over each 8 hours of a 40 hour work week (ACGIH, 1991 - 92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact. Contact with hot surfaces that can cause thermal decomposition of caprolactam.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may initially be present in air in the immediate vicinity and directly downwind of a spill of molten caprolactam. High levels of dusts or mists also pose a hazard if they somehow become airborne, as may gases, vapors, or fumes generated from burning or thermally decomposing caprolactam. Direct contact or ingestion of the product should also be avoided.

Hazards of Skin or Eye Contact: Hot molten caprolactam may cause severe thermal burns upon contact with the skin or eyes. Contact of solid caprolactam or its aqueous solutions with the eyes is reported to cause moderate to severe irritation. Skin contact with these forms is reported to cause mild irritation (if any) unless the contact is prolonged and confined, in which case the exposure may cause serious burns. Exposure to airborne dust at a concentration of 5 mg/m^3 causes skin irritation in some people but this is reported not to occur at a level of 1 mg/m^3. Some amounts of caprolactam may be absorbed through intact skin but the toxic hazard by this of exposure is apparently low, requiring large and prolonged exposures to have an effect.

Hazards of Inhalation: Inhalation of caprolactam dust, vapors, or mists is reported to cause irritation of the nose and throat, coughing, and chest discomfort. Inhalation of high concentrations may cause headaches, nausea, vomiting, and coma. Very high concentrations or prolonged exposures may cause unconsciousness. The saturated vapor concentration over a pool of molten caprolactam is about 3950 ppm at a pool temperature of 212°F. High concentrations may also be experienced where caprolactam dusts or mists become airborne due to various circumstances.

Hazards of Ingestion: Caprolactam is considered moderately toxic by ingestion. Intake of relatively large quantities is reported to cause nausea and vomiting. A maker of the product reports that when caprolactam is administered in large doses to animals, it is a convulsive poison, a powerful respiratory system stimulant, and a mild circulatory system depressant that also causes reduced body weight.

FIRE HAZARDS

Lower Flammable Limit: 1.4% to 1.84%

Upper Flammable Limit: 8%

Behavior in Fire: Combustible solid product may require substantial preheating prior to ignition but powder or dust may be more easily ignited. Molten liquid may also require significant preheating since the flash point of caprolactam is quite a bit higher than its melting point.

Hazardous Combustion Products: Burning caprolactam is reported to produce irritating and toxic gases and aerosols which may contain oxides of nitrogen, hydrogen cyanide, carbon monoxide, carbon dioxide, and possibly other hazardous substances. Thermal decomposition at high temperatures may also cause evolution of some or all of these materials. Be advised that oxides of nitrogen and hydrogen cyanide are very highly toxic. The combustion and thermal decomposition products of caprolactam may require special attention and precautions beyond those associated with caprolactam itself.

EXPLOSION HAZARDS

Explosiveness: Explosion potential is limited unless caprolactam is heated above its flash point and its vapors are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with hot molten caprolactam. Otherwise, for “cool” solids or liquids containing caprolactam, equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, dust or splash-proof safety goggles as appropriate, and other impervious and resistant clothing. Be advised that handling of hot molten caprolactam may require clothing that provides protection against high temperatures. Handling of "cool" solids may possibly be accomplished using any of a wide range of clothing or glove materials. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with the smoke and fumes generated by burning or thermally decomposing caprolactam.

Respiratory Protection: For fire fighting or when vapors are being generated from hot caprolactam, a self contained breathing apparatus (SCBA) with full face piece (or the equivalent). For situations in which the vapor pressure of the product is low (e.g.,when the spilled product is at ambient temperature or consists of a solution of caprolactam in water), a gas mask with chin-style or front or back mounted organic vapor canister and dust/mist filter or a chemical cartridge respirator with a half or full face piece, organic face piece, organic vapor cartridge(s), and dust/mist filter(s) may be adequate within the use limitations of these devices. Be advised that some non-fire outdoor incidents may not require any respiratory protection whatsoever. Use professional judgment as necessary or seek the advice of qualified experts.

FIRST AID

Nonspecific Symptoms: Eye, skin, nose or throat irritation; headache, coughing, nausea, vomiting, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention if eye irritation persists after washing or a burn has occurred. If molten caprolactam contacts the skin, immediately flush the skin with large amounts of water, remove contaminated clothing, and get medical attention immediately. Note that removal of solidified molten material from the skin (or vicinity of the eyes) may require qualified medical assistance if the solid is not fully dissolved by the water. In other cases, promptly wash affected skin with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: This is a common recommendation but some authorities do not recommend that vomiting be induced after water is administered. Seek qualified medical advice on this issue if possible.) If vomiting is induced or occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs and then repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, foam, carbon dioxide. Authorities disagree as to whether regular or alcohol foam should be used; possibly both are effective to some degree. Solid streams of water may be ineffective. A few authorities recommend against the use of water on burning caprolactam because of the potential for violent frothing and or spattering of the product. It may be prudent to apply water as a fine spray with caution at first and to also be cautious when initially applying foam.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with fumes or smoke from burning caprolactam is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Be advised that introduction of water into a tank of very hot molten caprolactam may possibly result in frothing, boil over, and/or violent steam generation. Do not depend on pressure relief devices to limit pressure in, tank of molten liquid; these may possibly become plugged with solid.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Discharge of a carbon dioxide fire extinguisher at the point of leakage of hot molten caprolactam has the potential to solidify the caprolactam and stop the leak in some cases, at least temporarily. Other means of attempting to solidify the leaking caprolactam via cooling may also work. Whether or not the "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the tank and its temperature. It may become necessary to repeat the procedure sever al times until the leak can be patched or to ultimately abandon the effort. Use professional judgment in attempting this type of response action. Give special attention to the dangerous products of combustion or those of thermal decomposition that may evolve at high temperatures. Use professional judgment with respect to which precautionary measures listed above and others are most suitable for a given situation. The caprolactam may be molten, a solid, or a solution in water (or in another liquid, in which case additional hazards not addressed in this Guide may be present). Hazards will vary somewhat in severity and type depending on the form and temperature of the material.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION…Caprolactam may not evolve significant amounts of hazardous airborne contaminants in many outdoor spill situations, especially if it is discharged as a "cool" non-dusty solid or solution in water. It may be advisable in such cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of caprolactam may be found in air in the local spill area and immediately downwind if its dusts or mists become airborne.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas and areas immediately downwind as necessary.

TECHNIQUE

EVACUATION…Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors allow vapors to dissipate. Caprolactam discharges may expose certain downwind areas to toxic concentrations in some cases, particularly and especially if large quantities of the very hot molten liquid have been discharged. Burning or thermally decomposing caprolactam may also evolve highly toxic gases, vapors, and fumes into the atmosphere.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary. Note that the vapor pressure of the molten product and its vapor emission rate will decrease as it solidifies and cools in the ambient environment or if various means (see below) are used to accelerate its rate of cooling.

TECHNIQUE

PROTECTION FROM WIND…Where deemed necessary, cover spilled solid caprolactam with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY…Where deemed necessary, water fog or spray applied to caprolactam vapors in air may absorb them or accelerate their dispersal in the atmosphere. Similarly, this response may knock down any mists or dusts in air. Cooling of spills of molten caprolactam with water spray may solidify and cool the product, thus reducing its temperature and vapor emission rate. Maintenance of a layer of water on top of a contained pool of molten caprolactam that has solidified on its surface may greatly reduce vapor emissions.

CAPROLACTAM

Class 9 (Miscellaneous Hazardous Materials)

CONSEQUENCE

Water runoff may contain varying amounts of caprolactam. As discussed earlier, there is a possibility that contact of very hot molten caprolactam with a water spray may result in potentially violent frothing and spattering of the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Apply water spray with caution to hot molten caprolactam at first.

TECHNIQUE

FOAM…Where deemed necessary, foam applied to the surface of liquid pools of the molten liquid may slow the release of caprolactam vapors into the atmosphere. Note that authorities disagree as to whether regular or alcohol foam is most suitable; both may be effective to some degree.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. As discussed earlier, there is a possibility that contact of very hot molten caprolactam with foam may result in potentially violent frothing and spattering of the product.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply foam with caution to hot molten caprolactam at first.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES…Caprolactam in most forms may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained caprolactam solutions or contaminated water used for cooling or other purposes may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible and deemed necessary, line collection basins with a compatible impervious material.

TECHNIQUE

EXCAVATION…A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION…Accumulated liquid pools of contaminated water or caprolactam solutions may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. This response is unlikely to be appropriate for molten caprolactam since cooling of the product may result in its solidification and subsequent plugging or clogging of transfer or storage equipment.

CONSEQUENCE

Equipment that is incompatible with the liquid being recovered may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the liquid being recovered.

CAPROLACTAM

Class 9 (Miscellaneous Hazardous Materials)

TECHNIQUE

ABSORPTION…Spreading of caprolactam solutions or contaminated water may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATLON

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Non-combustible sorbents are preferred in order to reduce the hazard the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL…Contaminated soil or spilled product or its residues may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines as appropriate.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or combustible dusts present in the area may be ignited by motorized removal equipment, particularly in the case of very hot molten caprolactam or where caprolactam dust is present. Improper removal techniques may cause caprolactam dust to become airborne where the solid product has spilled. Hot surfaces of motorized equipment may cause thermal decomposition of caprolactam if contaminated, thus resulting in evolution of highly toxic and irritating gases and fumes.

MITIGATION

Select removal procedures that do not cause caprolactam dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable or combustible atmospheres. Eliminate ignition sources. Take precautions not to handle solid caprolactam in a manner that generates airborne dusts. Apply appropriate precautions if use of motorized equipment may result in the heating and thermal decomposition of caprolactam. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE…Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Caprolactam will readily dissolve in water. Available data indicate that the substance is of low toxicity to at least some types of fish. A concentration of one ppm can affect the self-purification of water, however, and nitrification decreases from 100 ppm onwards. No information could be found on water treatment or product recovery methods for spills of caprolactam into water. It does appear, however, that the substance may biodegrade if the water is treated with appropriate bacteria adapted to the material.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES…Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Consult qualified experts for suitable treatment or disposal options

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Mitigation Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

March 1995

CARBOLIC ACID or PHENOL

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Carbolic acid, more commonly known as phenol, is a colorless solid or light pink to reddish liquid with an acrid, sweet, tarry, medicinal odor. It is of relatively low volatility and is used to make adhesives, coatings, plastics, agricultural chemicals, pharmaceuticals, and a wide variety of other chemicals and products. It is moderately soluble in water and slightly heavier, so may be expected to sink while dissolving fairly rapidly. Its flash point of 175°F indicates that the product must be preheated before ignition may occur easily. The product weighs approximately 8.9 pounds per gallon.

Phenol does not react with water or many other common materials and is stable in normal transportation. It is reactive with various chemicals, however, and may be corrosive to lead, aluminum and its alloys, and certain plastics, rubber, and coatings. Hot liquid phenol will additionally attack magnesium and zinc metals. Phenol is highly toxic by all routes of exposure and is considered a poison. Products of combustion may contain unburned phenol and possibly other toxic constituents.

If the material is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 8.4 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, hot benzene, carbon disulfide and tetrachloride, chloroform, and ether.
Specific Gravity (Liquid): 1.072 at 68°F (20°C)
Boiling Point: 359.2°F (181.8°C) at 1 Atm.
Melting Point: 109.4°F (43°C)
Freezing Point: 105.6°F (40.9°C)
Molecular Weight: 94.11
Heat of Combustion: -7445 cal/g
Vapor Pressure: 0.36 mm Hg (0.007 psia) at 68°F (20°C)
Flash Point: 175°F (79.4°C), closed cup; 185°F (85°C), open cup.
Autoignition Temperature: 1319°F (715°C)
Burning Rate: 3.5 mm/minute
Stability: Stable
Corrosiveness: Corrosive to lead, aluminum and its alloys, and some forms of plastics, rubber, and coatings. Hot liquid phenol will also attack magnesium and zinc metals.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizers (especially calcium hypochlorite), aluminum chloride, nitrobenzene, butadiene, and alkaline materials.

IDENTIFICATION

Shipping Names: Phenol, solid (USDOT and IMO); carbolic acid (USDOT and IMO); phenol, solution (USDOT and IMO)
Synonyms and Tradenames: Hydroxybenzene; phenic acid; phenylic acid; benzenol; oxybenzene; monohydroxybenzene; phenyl alcohol; phenyl hydrate; phenyl hydroxide; phenylic alcohol; benzophenol.
Chemical Formula: C_6H_5OH
Constituent Components(% Each): 90-99% pure solid; 60-85% pure liquid with water; or 82-92% grade with 8-18% cresol.
UN/NA Designation: UN1671 (USDOT and IMO) solid; UN2312 (USDOT and IMO, molten); UN2821 (USDOT and IMO solutions)
Imo Designation: 6.1, poisonous substance
Physical State as Shipped: Solid or liquid
Physical State as Released: Solid or liquid
Color of the Shipped Material: Colorless to light pink to red depending on purity
Odor Characteristics: Sweet, tarry, acrid, pugent, medicinal
Common Uses: Mfg. adhesives, coatings, plastics, resins, pharmaceuticals, dyes, perfumes, fungicides, surfactants, disinfectants, and other chemicals and products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CARBOLIC ACID or PHENOL

Division 6.1 (Poisonous Material)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.047-0.5 ppm

Unusual Hazards: Highly toxic substance that is rapidly absorbed through the skin. Vapors may deaden the sense of smell. Contaminated leather shoes and clothes have been a source of poisoning. Phenol vapors can contaminate cigarettes.

Short Term Exposure Limits(STEL): (Skin) 10 ppm for 15 minutes.(ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 5 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Phenol may cause systemic poisoning from any route of exposure, especially after skin contact. Vapor readily penetrates the skin with an absorption efficiency equal that for inhalation.

Hazards of Skin or Eye Contact: Contact of the skin with phenol does not cause pain but may result in whitening of the exposed area followed by a severe burn or systemic poisoning if the material is not removed promptly. Contact with the eyes may cause severe damage and blindness.

Hazards of Inhalation: Vapors of phenol are irritating to the eyes, nose, and throat. Systemic effects of over exposure may include difficulty in breathing, coughing, lung damage, twitching, cyanosis, convulsions, sudden collapse, coma, and death. Chronic poisoning may also cause vomiting, difficult swallowing, diarrhea, headache, dizziness, mental disturbances, and other effects.

Hazards of Ingestion: Ingestion of lethal amounts (as little as 1 gram) causes severe burns of the mouth and throat, abdominal pain, cyanosis, weakness, collapse, coma, and death; tremors, convulsions, or muscle twitching have also been observed but were not severe. Nausea, vomiting, and jaundice are also possible symptoms.

FIRE HAZARDS

Lower Flammable Limit: 1.5-1.7%

Upper Flammable Limit: 8.6%

Behavior in Fire: Combustible. Will burn but difficult to ignite unless heated.

Hazardous Combustion Products: Not well-defined, likely to include unburned phenol and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of heated phenol are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/natural rubber, polyethylene, and chlorinated polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full face piece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister and dust and mist filter (100 ppm or less) or an organic vapor cartridge respirator with a full face piece and dust and mist filter(s) (100 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, or throat; other symptoms of overexposure, especially sudden collapse.

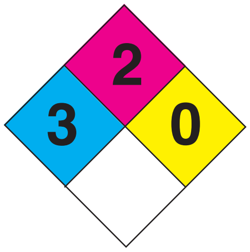
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

1671

CARBOLIC ACID or PHENOL
Division 6.1 (Poisonous Material)



See UN/NA Designation for
other ID numbers.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense smoke/fumes anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid all contact with the spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Take into account while planning the response that phenol is rapidly absorbed through the skin.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Phenol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of phenol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND ... If necessary, cover solid phenol with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog/spray applied to phenol vapors or dust may absorb vapors, knock down dust, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of phenol from contact with its vapors or dust.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rain water that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM ... Firefighting foam applied to the surface of liquid pools may slow the release of phenol vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam break down will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

CARBOLIC ACID or PHENOL
Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Phenol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained phenol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose run off or rain water that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled liquid may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

CARBOLIC ACID or PHENOL

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUES

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT ... Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination. (Note: phenol may dissolve in water at an appreciable rate. This response may only be effective under appropriate circumstances.)

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING ... Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery. (Note: This response may only be effective under conditions such that phenol does not rapidly dissolve in water.)

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Ion exchange resins may also be effective.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

CARBON DIOXIDE
Nonflammable Gas

GENERAL INFORMATION

Carbon dioxide is a colorless, odorless, non combustible gas that is shipped in tanks as a liquid under pressure but only exists as dry ice or gas at ordinary atmospheric pressure. It is used in fire extinguishers, as a refrigerant, for the carbonation of beverages, and in a variety of other processes and products. It is slightly soluble in water but does not pose a significant water pollution hazard in typical transportation accidents. The liquid weighs approximately 8.5 pounds per gallon. The gas is heavier than air and may persist in low areas. It can asphyxiate by the displacement of air. Low temperatures pose a frostbite hazard due to contact with venting liquid, solid, or gas. Containers may rupture due to over pressurization if exposed to fire or excessive heat for sufficient time duration.

Carbon dioxide is stable in normal transportation. It forms a weak carbonic acid in water. It does not react with many other common materials, but the liquid or solid may attack some forms of plastics, rubber, and coatings. (Note: Carbon dioxide is designated as hazard class ORM-A by the USDOT when shipped in its solid form.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.14 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone and alcohol.
Specific Gravity (Liquid): 1.02
Boiling Point: Not pertinent, dry ice sublimes
Melting Point: –109.3°F (–78.5°C)
Freezing Point: –109.3°F (–78.5°C)
Molecular Weight: 44.0
Heat of Combustion: Not flammable
Vapor Pressure: 60 atm (881.4 psia) at 72.3°F (22.4°C); 1 atm at –108.8°F (–78.2°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: May attack some forms of plastic, rubber, or coatings.
Reactivity with Water: Forms weak carbonic acid in nonhazardous reaction.
Reactivity with Other Chemicals: Contact with chemically active metals like sodium, potassium, or hot titanium may cause fire. May react with alkaline or amine compounds or compounds of active metals.

IDENTIFICATION

Shipping Names: Carbon dioxide, refrigerated liquid (USDOT, IMO); carbon dioxide, solid (USDOT); dry ice (USDOT); carbonice (USDOT); carbon dioxide (IMO).
Synonyms and Tradenames: Carbonic acid gas; carbonic anhydride, carbon oxide.
Chemical formula: CO_2
Constituent Components(% each): 99.5% or more pure
UN/NA Designation: UN2187 (refrigerated liquid); UN1013; UN1845 (solid)
IMO Designation: 2.2, Nonflammable gas; 9, misc. dangerous substance
Physical State as Shipped: Liquefied compressed gas or solid
Physical State as Released: Gas and/or dry ice
Color of the Shipped Material: Colorless, but may appear white
Odor Characteristics: Odorless
Common Uses: Refrigeration; carbonation; fire extinguishant; aerosol propellant; water treatment; used in welding, inerting and purging of equipment, making of aspirin, white lead, weak acids, dry ice, and other chemicals; used in food preservation and medicine.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CARBON DIOXIDE
Nonflammable Gas

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Heavier than air gas may cause asphyxiation via displacement of air and may persist in low areas. Cold product may cause frostbite.

Short Term Exposure Limits(STEL): 15000 ppm for 15 minutes.(ACGIH)

Time Weighted Average(TLV-TWA): 5000 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Contact with incompatible materials; inhalation of high gas concentrations; physical contact with cold product in any form.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high gas concentrations that may be present in air and that may persist in pits or depressions. Frostbite from direct contact is also to be avoided.

Hazards of Skin or Eye Contact: Skin or eye contact with cold carbon dioxide discharged from a container in any form may result in frostbite.

Hazards of Inhalation: Carbon dioxide gas is an asphyxiant, a potent respiratory stimulant, and both a stimulant and depressant of the central nervous system. Levels near 10% in air may cause coma and asphyxiation in a few minutes. At 5% there may be shortness of breath and headache. Levels of 2% cause similar symptoms within several hours upon mild exertion. Additional symptoms may include dizziness, restlessness, sweating, malaise, and increased heart rate and blood pressure. Very high concentrations cause convulsions.

Hazards of Ingestion: Solid carbon dioxide may cause frostbite in contact withthe mouth, throat, or other bodily tissues.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to over pressurization. Will generate large quantities of gas upon release.

Hazardous Combustion Products: Not flammable

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may rupture violently in fire due to over pressurization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct frostbite due to contact with carbon dioxide or equipment containing the product. This may include boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Shortness of breath, dizziness, headache, or other symptoms of inhalation; frostbite due to contact with cold product or surfaces.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately.

First Aid for Skin, Mouth, and Eye Contact: Stop exposure. Get medical attention immediately if eye contact has occurred with freezing product or if there is evidence of frostbite.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with very cold product. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. Note that addition of water to solid or liquid carbon dioxide may increase gas evolution rate in some cases.

1013

See UN/NA Designation for
other ID numbers.

CARBON DIOXIDE
Nonflammable Gas

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that carbon dioxide only exists as a gas or solid once discharged from its container. Note also that concentrated gas may persist inpits and depressions and that high pressures may be developed in sealed equipment containing carbon dioxide.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Carbon dioxide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed. (Note: Large spills in warm weather may require some degree of evacuation.)

CONSEQUENCE

Hazardous levels of carbon dioxide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY... Water fog or spray applied to carbon dioxide gas may accelerate its dispersal in the atmosphere. Apply water from a point downwind and do not allow it to contact solid product as this may increase gas evolution.

CONSEQUENCE

Water run off may contain a small amount (if any) of carbon dioxide from contact with airborne gas.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose run off or rain water that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines if necessary. Otherwise, carbon dioxide may simply be permitted to evaporate.

CONSEQUENCE

High pressure may develop in sealed containers.

MITIGATION

Store contaminated materials in safe and secure location with adequate ventilation.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent maybe used to neutralize soil or water acidified by carbon dioxide where such treatment is found necessary.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water intake for contamination if carbon dioxide in water can adversely affect their operations. Solid carbon dioxide will sink in water and generate bubbles of gas until completely vaporized. Some gas will dissolve in water to form a weakly acidic solution.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CARBON DIOXIDE
Nonflammable Gas

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: Carbonated water is toxic to various aquatic organisms.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques and the need for such treatment.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

CARBON DISULFIDE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Carbon disulfide is a volatile, colorless and flammable liquid with a faint sweetish disagreeable odor like decaying cabbage. It is used as a solvent, as a fumigant, and for making rayon, cellophane, pharmaceuticals and a variety of other products and chemicals. It is heavier than water and only slightly soluble, so may be expected to sink and dissolve at a slow rate. Its flash point is -22ºF with a wide flammable range that indicates that the product can be ignited under all ambient temperature conditions, while its unusually low autoignition temperature of 194-212ºF suggests that ignition is easily accomplished by even a lighted electric bulb. The product is highly volatile and generates heavier than air vapors. These may travel a considerable distance to a source of ignition and flash back, and may persist in low areas. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat. The product weights approximately 10.5 pounds per gallon.

Carbon disulfide does not react with water or many other common materials and is stable in normal transportation. It is incompatible with aluminum, zinc, and a variety of other substances, however, and will attack some plastics, rubber, and coatings. Its toxic hazard is high by most routes of exposure. Products of combustion may include toxic sulfur oxide and carbon monoxide gases.

Downwind evacuation should be considered if carbon disulfide is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.2 g/100 g water at 68ºF (20ºC)
Solubility in Other Chemicals: Soluble in alcohol, chloroform, and ether.
Specific Gravity (Liquid): 1.26 at 68ºF (20ºC)
Vapor Density: 2.67
Boiling Point: 115ºF (46.3ºC) at 1 atm.
Melting Point: See freezing point.
Freezing Point: -168.9ºF (-111.6ºC)
Molecular Weight: 76.14
Heat of Combustion: -3230 cal/g
Evaporation Rate (butyl acetate=1): 22.6
Vapor Pressure: 300 mmHg (5.8 psia) at 68ºF (20ºC)
Flash Point: -22ºF (-30ºC), closed cup
Autoignition Temperature: 194 - 212ºF (90 - 100ºC)
Burning Rate: 2.7 mm/minute
Flammable Limits: 1.3% (LEL) - 50% (UEL)
Stability: Stable, but decomposes upon standing in air.
Polymerization Potential: Will not occur.
Corrosiveness: Slightly corrosive to some metals; will attack some plastics, rubber, and coatings. Incompatible with zinc and aluminum.
Reactivity with Water: No reaction
Reactivity and Incompatibility: Reacts with aluminum, strong oxidizers, chemically active metals, azides, amines, bases, chloride, imines, fluorine, nitrogen oxides, acid and permanganates, chlorine, and certain other compounds of active metals. May form explosive salts in contact with azides.

IDENTIFICATION

Shipping Name(s): Carbon disulfide (USDOT); Carbon disulphide (IMO).
Synonyms and Tradenames: Dithiocarbonic anhydride; Carbon bisulfide; Carbon bisulphide; Carbon sulfide; Sulphocarbonic anhydride.
CAS Registry No.: 75-15-0
Chemical Formula: CS_2
Constituent Components (% each): Close to 100% pure.
UN/NA Designation: UN1131
IMO Designation: 3.1, Flammable liquids
RTECS Number: FF6650000
NFPA 704 Hazard Rating: 3(Health): 4(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, disagreeable, like decaying cabbage, but faint.
Reportable Quantity: See appendix I.
Common Uses: Solvent; fumigant; mfg. of rayon, cellophane, pharmaceuticals, pesticides, soil conditioner, paper, matches, optical glass, rubber, dyes, and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CARBON DISULFIDE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.0011-7.7 ppm, reported values vary.

Unusual Hazards: Highly volatile, toxic, and flammable liquid with heavier than air vapors. Can be ignited by relatively low temperature ignition sources.

Short Term Exposure Limit (STEL): 10 ppm (30 mg/m^3) (can be absorbed through skin)

Time Weighted Average (TLV-TWA): 1 ppm (3 mg/m^3) (can be absorbed through skin).

Ceiling (C) Limit: 30 ppm

IDLH: 500 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations that may be present. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Skin contact with liquid carbon bisulfide or concentrated vapors may cause irritation, blisters, and/or burns depending on length of exposure. The product can be absorbed via skin in toxic amounts. Splashes of liquid in the eyes cause immediate and severe irritation.

Hazards of Inhalation: Vapors of carbon bisulfide irritate the eyes and nose and may cause headache, nausea, nervous system excitation, drop in blood pressure, dizziness, unconsciousness, and death in acute exposures. Concentrations of 1150 ppm in air cause serious symptoms; 4800 ppm for 30 minutes may be fatal. Repeated low level exposures may result in a variety of nervous system, reproductive, ocular, cardiovascular, and other effects.

Hazards of Ingestion: Ingestion may cause vomiting, diarrhea, headache, convulsions, coma, and possibly death due to respiratory paralysis.

FIRE HAZARDS

Lower Flammable Limit: 1-1.3%

Upper Flammable Limit: 50%

Behavior in Fire: Flammable liquid. Vapors are flammable and heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable vapors upon release.

Hazardous Combustion Products: Includes toxic sulfur oxide, carbon dioxide and carbon monoxide gases.

EXPLOSION HAZARDS

Explosive Limit: Unavailable

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Contact with oxides may result in formation of explosive mixtures.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

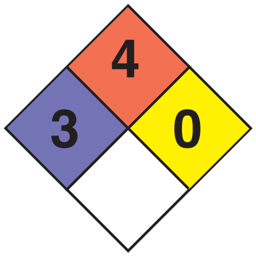
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Polyvinyl ACL (PVAL) and Viton® are reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge (500 ppm or less).

1131

CARBON DISULFIDE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If patient is conscious and can swallow, give 16 ounces of water and induce vomiting. Do not make an unconscious person vomit. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, other inert gas, foam. Foam may be ineffective. Water may possibly be used as a blanket over contained liquid.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of carbon disulfide may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment. Take into account while planning a response that carbon disulfide is highly volatile, flammable, toxic, and easily ignited.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may produce large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

CARBON DISULFIDE

Class 3 (Flammable Liquid)

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to carbon disulfide vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments and will accumulate in low lying areas.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

FOAM . . . Foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications and monitor the area until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

COVERAGE WITH WATER . . . Coverage of confined carbon disulfide with a blanket of water may slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may confine spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

CARBON DISULFIDE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CARBON DISULFIDE

Class 3 (Flammable Liquid)

TECHNIQUE

CONFINEMENT . . . Spilled product will sink in water. Use natural deep-water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep-water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

CARBON MONOXIDE

Division 2.3 (Poison Gas)

GENERAL INFORMATION

Carbon monoxide is a colorless and odorless product shipped as a compressed or liquefied compressed gas. The gas or vapor is highly toxic and is well known to interfere with the ability of the blood to convey oxygen to bodily tissues. It is used in gaseous fuels and in the making of other chemicals. Being only slightly soluble in water and lighter, little of the liquid product will dissolve before it boils or rapidly evaporates from the surface of a water body, yet even relatively small amounts dissolved in water can be harmful to aquatic organisms. Its very low boiling point and wide range of flammability indicate that large amounts of gas or vapor may evolve from spills, especially if the liquid product is involved, and may be easily ignited under all ambient temperature conditions. Vapors may be heavier than air when cold, may persist in low areas until warmed, and in any case may travel a considerable distance to a source of ignition and flash back. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. Liquid carbon monoxide weighs approximately 6.6 lbs/gal at its boiling point temperature. Carbon monoxide does not react with water or many common materials and is stable in transportation, but does react in a vigorous or violent fashion with a variety of other chemicals. Contact with the liquid or very cold gas may cause frostbite burns of the skin or eyes. Products of combustion include carbon, carbon dioxide, and possibly other oxides of carbon. Downwind evacuation should be considered if carbon monoxide is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a fire involving a bulk container becomes uncontrollable or the container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently. If a cylinder is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.00448/1008 water at 32°F (0°C)

Solubility in Other Chemicals: Soluble in alcohol, benzene, ammonium hydroxide, ethyl acetate, acetic acid, and trichloromethane.

Specific Gravity (Liquid): 0.79 at boiling point.

Vapor Density: .97

Boiling Point: -312.7°F (-191.5°C) at 1 atm.

Melting Point: -340.6°F (-207°C) to -326.2°F (-199°C); reported values vary.

Freezing Point: See melting point

Molecular Weight: 28.0

Heat of Combustion: -2412 cal/g

Evaporation Rate (butyl acetate=1): Not applicable

Vapor Pressure: Usually above critical temperature when compressed gas; maximum pressure allowed in a cylinder is 113.3 atm (1650 psig).

Flash Point: Flammable gas

Autoignition Temperature: 1128°F (609°C) or 1206°F (652°C); reported values vary.

Burning Rate: Unavailable

Flammable Limits: 12% (LEL) - 75% (UEL)

Stability: Stable

Polymerization Potential: Will not occur.

Corrosiveness: Non-corrosive to metals at pressures below 500 psig. May react with iron, nickel, and certain other metals at higher pressures to form carbonyls.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reactions with bromine trifluoride, chlorine trifluoride, lithium and water, nitrogen trifluoride, oxygen difluoride, liquid oxygen (with liquid CO), potassium, or sodium (with liquid ammonia) may result in explosions under appropriate conditions. Iodine heptafluoride or cesium monoxide may burn in carbon monoxide. Incompatible with oxidizing agents in general.

IDENTIFICATION

Shipping Name(s): Carbon monoxide, compressed gas (USDOT & IMO); Carbon monoxide, refrigerated liquid (USDOT).

Synonyms and Tradenames: Carbonic oxide; carbon oxide; Flue gas, Monoxide.

CAS Registry No.: 630-08-0

Chemical Formula: CO

Constituent Components (% each): 97.5% or more pure depending on grade.

UN/NA Designation: NA9202 (refrigerated liquid); UN1016 (compressed gas)

IMO Designation: 2.3, Toxic gas

RTECS Number: FG3500000

NFPA 704 Hazard Rating: 3(Health): 4(Flammability): 0(Reactivity)

Physical Form as Shipped: Compressed gas or liquefied compressed gas

Physical Form as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Odorless

Reportable Quantity: See appendix I.

Common Uses: Organic synthesis; fuels (gaseous); metallurgy; zinc white pigments; mfg. of metal carbonyls.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CARBON MONOXIDE

Division 2.3 (Poison Gas)

* 1016 (Compressed) 9202 (Refrigerated liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Highly toxic and flammable product with extremely low boiling point. Wide range of flammability. Cold vapors and gases may be heavier than air and persist in pits, hollows, and depressions.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 35 ppm (40 mg/m^3)

Ceiling (C) Limit: 200 ppm (229 mg/m^3)

IDLH: 1200 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact with very cold liquid, gas, or containers.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high gas concentrations that may be present in the spill area and over considerable downwind distances. Direct contact with the very cold product and cold containers is also to be avoided.

Hazards of Skin or Eye Contact: Exposure of the skin or eyes to liquid carbon monoxide or very cold gas may cause frostbite-type burns.

Hazards of Inhalation: Carbon monoxide readily combines with blood hemoglobin, thus interrupting the normal oxygen supply to bodily tissues. Symptoms of exposure include headache, dizziness, weakness, rapid breathing, visual disturbances, nausea, vomiting, incoordination, acidosis, coma, convulsions, brain damage, and possibly death with the skin first becoming pale and later cherry red in color. High concentrations may cause collapse and coma with little warning. Some permanent effects of excessive overexposure may be evident even after resuscitation. Levels of 600 - 700 ppm usually cause minor effects in one hour, but 1500 - 2000 ppm is dangerous. Levels of 4000 ppm and above are fatal in less than one hour. Heavy smokers and those with heart or other diseases may be at greater risk. Effects are aggravated by heavy work, high temperatures, and high altitudes.

Hazards of Ingestion: Due to its properties, ingestion of liquid carbon monoxide is considered highly unlikely.

FIRE HAZARDS

Lower Flammable Limit: 12%

Upper Flammable Limit: 75%

Behavior in Fire: Flammable compressed or liquefied compressed gas. Will generate large quantities of toxic and flammable gas upon release. Vapors may be heavier than air when cold and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Flames may be violet or bright blue and/or with little color.

Hazardous Decomposition Products: Decomposes into carbon, carbon dioxide, and possibly other oxides of carbon.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with other chemicals listed in the reactivity section may result in formation of explosive mixtures.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Protective clothing and equipment should prevent the skin or eyes from becoming frozen from contact with liquid carbon monoxide, cold gas streams, or cold vessels containing the product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

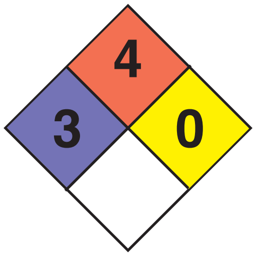
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge may suffice.

1016

9202

CARBON MONOXIDE

Division 2.3 (Poison Gas)



FIRST AID

Nonspecific Symptoms: Frostbite, dizziness, weakness, nausea, headache, rapid breathing and other symptoms of carbon monoxide exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious, administer artificial respiration. Administer oxygen if victim remains unconscious or breathing is difficult. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Reports vary regarding removal of clothing, due to possibility of frostbite. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Ingestion is highly unlikely.

FIRE RESPONSE

Extinguishing Agents: Stop flow if possible or else allow fire to burn itself out while cooling adjoining equipment with water spray. Dry chemical, carbon dioxide, water spray or halon may be used for extinguishment when reignition of escaping gas is no longer a possibility.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay way from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water where such contamination has occurred. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Take the highly toxic, flammable, and volatile nature of carbon monoxide into account when planning the response. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows, and depressions.

AIR RELEASE

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CARBON MONOXIDE

Division 2.3 (Poison Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to carbon monoxide vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of carbon monoxide from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Liquid carbon monoxide may be confined by building dikes or barriers using soil, sand or other materials. Note that any spilled liquid will boil vigorously at first and continue to vaporize rapidly.

CONSEQUENCE

Confined carbon monoxide may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CARBON MONOXIDE

Division 2.3 (Poison Gas)

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: Carbon monoxide is toxic to various aquatic organisms at low concentrations in water.)

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert to conditions that may lead to overflow or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

This page may be used for notes.

March 1995

CARBON TETRACHLORIDE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Carbon tetrachloride is a colorless liquid with the sweet, pungent, or ethereal odor of chlorinated solvents. It is used as a grain fumigant, as a solvent, and in making other chemicals and products. It is very slightly soluble in water and heavier, so may be expected to sink and dissolve extremely slowly. It is not flammable and has been used as a fire extinguishing agent in the past. Containers may rupture due to overpressure if exposed to fire or excessive heat for sufficient time duration. The liquid product weighs approximately 13.2 pounds per gallon. Vapors are heavier than air and may persist in low areas.

Carbon tetrachloride does not react with water or many other common materials. It is stable in normal transportation but may explode or react violently in contact with burning wax, burning aluminum, burning magnesium, burning calcium hypochlorite, and certain other materials. An unusual hazard is that aluminum and this product may detonate when heated or shocked, especially if the aluminum is powdered. The product is considered to be highly toxic by ingestion or inhalation, somewhat less toxic by skin absorption, and is suspected of being a carcinogen. At high temperatures, or in contact with hot metal, carbon tetrachloride may decompose to emit highly toxic gases and vapors such as hydrogen chloride, chlorine, phosgene, and carbon monoxide.

Downwind evacuation should be considered on a case by case basis if carbon tetrachloride is leaking from its container.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.08 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, ether, solvent naphtha and most fixed and volatile oils.

Specific Gravity (Liquid): 1.584-1.587 at 68°F (20°C)

Boiling Point: Approx. 170.2°F (76.8°C) at 1 atm.

Melting Point: – 8.7 To – 9.4°F –22.6 to –23°C)

Freezing Point: – 9.4°F (– 23°C)

Molecular Weight: 153.8

Heat of Combustion: Not flammable

Vapor Pressure: 91.3 mm Hg (1.77 psia) at 68°F (20°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable at moderate temperatures when dry.

Corrosiveness: Corrodes iron and certain other metals when in contact with water and especially at high temperatures. May react with aluminum to form explosive mixture. Will attack some forms of plastics, rubbers, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with burning aluminum, magnesium, wax, calcium hypochlorite, plutonium, uranium, and borane. Also reactive with allyl alcohol, aluminum, triethyl aluminum sequichlorides, aluminum triethyl, barium, disilane, disiloxane, lithium, magnesium powder, liquid oxygen, trisilane, tetrasilane, potassium and its alloys, sodium, zirconium, and several other substances.

IDENTIFICATION

Shipping Names: Carbon tetrachloride (USDOT and IMO)

Synonyms and Tradenames: Tetrachloromethane; perchloromethane; methanetetrachloride; necatorina; necatorine; benzinoform; carbona; carbon chloride; carbon tet; Freon 10; Halon 104; tetrachlorocarbon; tetrafinol; tetraform; tetrasol; univerm; vermoestricid; fasciolin; flukoids

Chemical Formula: CCl_4

Constituent Components(% each): Technical grade is 99.9+% pure

UN/NA Designation: UN1846

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Like chloroform; sweet, pungent; ethereal odor like other chlorinated solvents.

Common Uses: Grain fumigation; general solvent use; mfg. of fluorocarbons, resins, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CARBON TETRACHLORIDE

Division 6.1 (Poisonous Material)

USDOT: No placard is required
(49 CFR §§172-336 (b) and 172-500).

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10-50 ppm (approx.)

Unusual Hazards: Product is a suspected occupational carcinogen. Reacts violently or explosively with numerous materials (see General Information section). Decomposition products are highly toxic. Vapors are heavier than air.

Short Term Exposure Limits(STEL): (Skin) 20 ppm for 15 minutes.(ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 5 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Contact with incompatible materials and excessive heat or flame; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Carbon tetrachloride is toxic by ingestion orinhalation, slightly toxic via skin absorption. It is suspected to be a carcinogen.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact may cause moderate irritation, defatting of skin, and dermatitis. Liquid can be absorbed through the skin in toxic amounts. Contact of liquid with eyes may cause pain, severe irritation, redness, tearing and blurred vision but apparently minimal injury.

Hazards of Inhalation: Excessive inhalation may cause irritation, dizziness, weakness, fatigue, nausea, headache, incoordination, unconsciousness, and possibly death. Delayed effects may include severe damage to heart, liver, and kidneys up to 10 days later.

Hazards of Ingestion: Ingestion may result in gastrointestinal irritation, nausea, vomiting, and diarrhea. See effects of inhalation also.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture in fire due to overpressurization.

Hazardous Combustion Products: May decompose to toxic substances like hydrogen chloride, chlorine, phosgene, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Not flammable but containers may rupture in fire due to over pressurization. Contact with a variety of substances may result information of explosive mixtures (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

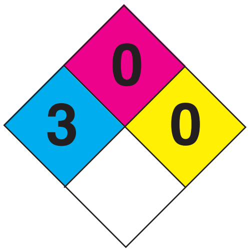
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include nitrile rubber, polyvinyl alcohol, polyurethane, Viton, nitrile rubber-PVC blend, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1846

CARBON TETRACHLORIDE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of skin, eyes, or respiratory tract. Dizziness, fatigue, weakness, nausea, vomiting, diarrhea, headache, incoordination, or unconsciousness.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Do not administer epinephrine or ephedrine as this may adversely affect the heart.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large amounts ofwater or a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: If ignites (unlikely), use carbon dioxide, drychemical, water spray or foam.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes/smoke from decomposition products anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Protect sewers and waterways from runoff. Take into account while planning the response that carbon tetrachloride is a moderately volatile and toxic liquid. Note the possibility of explosions in the presence of aluminum, especially if this metal is powdered.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Carbon tetrachloride may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of carbon tetrachloride in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Carbon tetrachloride spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CARBON TETRACHLORIDE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to carbon tetrachloride vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount of carbon tetrachloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM ... There is some possibility that firefighting foam applied to the surface of liquid pools may slow the release of carbon tetrachloride vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Carbon tetrachloride may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained carbon tetrachloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

CARBON TETRACHLORIDE
Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, orother compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT ... Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING ... Stream or lake beds may be dredged to remove heavier than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

CARBON TETRACHLORIDE

Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1996

CHLORINE*

Division 2.3 (Poison Gas)

GENERAL INFORMATION

Chlorine is a greenish yellow gas shipped under pressure as a liquid. It has a pungent suffocating odor like the odor of bleach and on inhalation will cause severe irritation to the respiratory passages. Liquid chlorine and high chlorine gas concentrations in air may cause severe eye and skin burns upon contact.

Chlorine is slightly soluble in water and heavier than water. When spilled in water, chlorine will sink and violently boil, releasing chlorine gas above the water's surface. Some chlorine will be dissolved in water. Due too its low boiling point, all chlorine discharges to the environment will result in the generation of large quantities of gas which is heavier than air. The gas is highly corrosive and toxic and may persist in pits, hollows, depressions and other confined or low lying areas. Although chlorine is not flammable, the product is a very strong oxidizer and most combustible materials will ignite and/or burn in chlorine atmospheres.

Chlorine is stable in normal transportation. On release, it is a highly reactive substance which may form potentially explosive mixtures with a wide variety of other chemicals and materials (see Explosion Hazards section). Containers of liquid may rupture due to over pressurization if exposed to fire or excessive heat for sufficient time duration. Downwind evacuation should be considered if chlorine is leaking from a container. Note that large spills may require evacuation over significant distances.

Chlorine is used to purify drinking water, to bleach paper, wood pulp and textiles, and for making a wide variety of other chemicals and products. The liquid weighs approximately 13 pounds per gallon near its boiling point temperature.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.65 gm/100 gm
Solubility in Other Chemicals: Soluble in alkalies.
Specific Gravity (Liquid): 1.424 at 59°F (15°C) Vapor
Density (Air = 1): 2.5
Boiling Point: -30.3 to -29.4°F (-34.1 to -34.6°C) at 1 atm.
Melting Point: -150° F (-101°C)
Freezing Point: -150° F (-101°C)
Molecular Weight: 70.91
Heat of Combustion: Not flammable.
Vapor Pressure: 4788 mmHg (6.3 atm) at 68° F (20°C)
Flash Point: Not flammable.
Autoignition Temperature: Not flammable.
Burning Rate: Not flammable.
Stability: Stable.
Corrosiveness: Highly corrosive in presence of moisture. Reacts with most metals at high temperatures. Copper may burn spontaneously.
Reactivity with Water: Forms a corrosive solution of hypochlorous acid (ClHO) which decomposes to chlorine, oxygen, and chloric acid.
Reactivity with Other Chemicals: Reacts with combustible substances and chemicals, finely divided metals, aluminum, certain plastics and rubbers, carbon, and a wide variety of metal compounds.

IDENTIFICATION

Shipping Names: Chlorine (USDOT and IMO).
Synonyms and Tradenames: Molecular chlorine; liquid chlorine; CAS 007782 50 5.
Chemical Formula: Cl_2
Constituent Components (% each): 99.95-100% pure with trace of inert ingredients.
UN/NA Designation: UN1017
IMO Designation: 2.3, poison gas.
Physical State as Shipped: Liquefied compressed gas.
Physical State as Released: Gas or boiling liquid.
Color of the Shipped Material: Greenish yellow.
Odor Characteristics: Pungent, choking, irritating, like bleach.
Common Uses: Used in water and sewage treatment; manufacture of pulp, paper, bleaches, disinfectants, dyes, rubber, plastics, inorganic and organic chemicals, and in other products and processes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

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*Reportable Quantity (RQ) established. Refer to appendix I.

CHLORINE

Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.02-3.5 ppm (0.058 - 10.15 mg/m^3)

Unusual Hazards: Extremely corrosive, toxic, volatile, and reactive substance. Will evolve large amounts of gas that may be toxic over considerable downwind distances. Gas is heavier than air and may persist in pits and depressions.

Short Term Exposure Limits (STEL): 0.3 ppm (0.8 mg/m^3). (OSHA)

Time Weighted Average (TLV-TWA): 0.1 ppm (0.25 mg/m^3) over each 8 hours of a 40 hour work week. (OSHA)

Conditions to Avoid: Contact with heat, water streams, or incompatible materials; runoff to sewers or water; inhalation, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of gas. Chlorine may disperse downwind in toxic concentrations over considerable distances. Direct physical contact will result in severe burns to exposed tissues.

Hazards of Skin or Eye Contact: Liquid chlorine may cause severe burns to skin or eyes upon contact. Symptoms may also include frostbite of exposed areas where liquid contact is involved. In high concentrations, chlorine gas irritates or burns the skin and may cause burns, inflammation, and blister formation. Eye contact may result in irritation, burns and in severe exposures, permanent eye damage.

Hazards of Inhalation: Chlorine gas may cause severe irritation of the eyes and respiratory tract with tearing, headache, runny nose, sneezing, coughing, choking, dizziness, and chest pain. Severe breathing difficulties may be delayed in onset and may involve tracheobronchitis, pulmonary edema, and pneumonia. A level of 1000 ppm may be fatal after a few deep breaths. Even 50 ppm may be dangerous in short exposures.

Hazards of Ingestion: Ingestion of chlorine is unlikely due to its physical characteristics.

FIRE HAZARDS

Lower Flammable Limit: Not flammable.

Upper Flammable Limit: Not flammable.

Behavior in Fire: Containers may rupture violently in fire due to over pressurization. Releases will generate large quantities of toxic gas. Although chlorine is not flammable, combustible materials will burn in chlorine gas atmospheres. Fire exposed containers may rupture due to over pressurization suddeenly releasing large volumes of liquid and gas.

Hazardous Combustion Products: Toxic products are evolved when combustibles burn in chlorine. These may include hydrogen chloride, free chlorine gas, and chlorine compounds formed with fuel combustion products.

EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently in fire due to over pressurization. Contact with other chemicals such as alcohols, hydrocarbons, hydrogen, pulverized metals, turpentine, acetylene, rubber, ether, ammonia, wax, fuel gas, polypropylene, and others may result in the formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

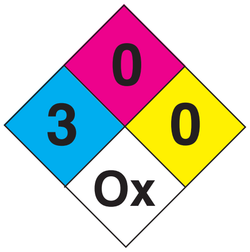
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene, chlorinated polyethylene, polyvinyl chloride, Viton, and Saranex.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style, front or back mounted chlorine canister, or a chlorine cartridge respirator with a full facepiece, within the use of limitations of these devices.

1017

CHLORINE

Division 2.3 (Poison Gas)



FIRST AID

Nonspecific Symptoms: Irritation or burns of any exposed bodily tissues. Coughing, wheezing and other symptoms of inhalation exposure. Frostbite and chlorine burns to tissues exposed to liquified chlorine.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit).

First Aid for Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Wash affected body areas with large amounts of water (do not use hot water or rub affected areas). Remove contaminated clothing after thawing. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Ingestion is unlikely due to the physical properties of chlorine.

FIRE RESPONSE

Extinguishing Materials: Chlorine is non flammable. Use materials appropriate to the fuel involved. Note that water contacting liquid chlorine or liquid chlorine pools may greatly increase the rate of vapor generation. Water spray may be used to protect personnel attempting shutoff of flow.

Extinguishing Techniques: Vapors are toxic and extremely corrosive. Avoid contacting chlorine liquid or chlorine liquid pools with fire fighting streams or runoff. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if without risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account the highly volatile, toxic, and reactive nature of chlorine when planning the response. Call CHEMTREC to activate CHLOREP (chlorine emergency response team). Note that the heavy gas may persist in pits, depressions, and other low lying or confined areas.

AIR SPILL

TECHNIQUE

EVACUATION…Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Chlorine spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Call CHEMTREC for specially available assistance from the chlorine industry.

TECHNIQUE

WATER FOG OR SPRAY…Water fog or spray applied to chlorine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact pools of liquid chlorine as this may increase gas evolution.

CONSEQUENCE

Water runoff may contain chlorine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

CHLORINE
Division 2.3 (Poison Gas)

TECHNIQUE

FOAM…Fluoroprotein foam or special chlorine foam applied to the surface of liquid pools may slow the release of chlorine vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if an initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES…Liquid chlorine may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained chlorine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION…A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION…Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines. The response is best suited to removing final traces of a spill where necessary.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

CHLORINE

Division 2.3 (Poison Gas)

WATER SPILL

TECHNIQUE

TOP USE…Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

August 1997

CHLOROACETIC ACID, SOLID

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Chloroacetic acid is a colorless to white or light brown hygroscopic crystalline solid with a strong odor resembling vinegar. It is used as a herbicide, preservative, disinfectant and in the manufacturing of various dyes and other chemicals. Its minor uses are as an intermediate to produce glycolic acids and their esters, caffeine and barbiturates and other pharmaceuticals. It is very soluble (becomes acidic pH=1.93) and will dissolve rapidly generating some amount of heat. It is corrosive to cast iron, steel, some stainless steel, copper, brass, aluminum, silver and lead. It is stable although it will react with alkalis, strong oxidizing agents, strong reducing agents and active metals. It is heavier than water. Its vapors are heavier than air but have a low vapor pressure. A flash point of 126°C (259°F) or greater indicates that the material is difficult to ignite. The solid weighs approximately 98.6 pounds per cubic foot.

Toxicity of the product is mostly related to its highly corrosive action on bodily tissues and it is important to note that the substance has a low vapor pressure. It is due to this characteristic that the hazards to health are mainly limited to direct skin or eye contact and ingestion, and not inhalation. However, inhalation is still a hazard especially in the form of dust. Products of decomposition or combustion are of special concern and include highly toxic and/or irritating hydrogen chloride, phosgene, carbon dioxide and carbon monoxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely; 421g/100g H_2O

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, carbon disulfide, carbon tetrachloride, chloroform, diethyl ether, ethanol, ether and methanol.

Specific Gravity: 1.41, 1.58 (both reported)

Vapor Density: 3.26

Boiling Point: 188-190°C (370-373°F)

Melting Point: 61-63°C (141.8-145.4°F)

Freezing Point: See melting point

Molecular Weight: 94.50

Heat of Combustion: -1843.2 kcal/g

Evaporation Rate (Butyl Acetate=1): 1

Vapor Pressure: 1 mm Hg (0.0193 psia) at 43°C (109°F)

Flash Point: 126-150°C (259-302°F)

Autoignition Temperature: 470°C (878°F), also reported to be greater than 500°C (932°F)

Burning Rate: Unavailable

Flammable Limits: 8%(LEL) - Unavailable

Stability: Stable

Polymerization Potential: Will not occur

pH: 1.93 (.1M Solution)

Corrosiveness: Corrosive to cast iron, steel, some stainless steel, copper, brass, aluminum, silver and lead.

Reactivity and Incompatibility: Reacts with alkalis, strong oxidizing agents, strong reducing agents and active metals.

Reactivity with Water: No reaction however solid generates heat while dissolving.

Other Characteristics: This substance is hygroscopic (readily absorbs moisture from the air). Pure chloroacetic acid exists in 4 crystalline forms (alpha, beta, gamma and delta). The alpha form is most stable and is most important in industry.

IDENTIFICATION

Shipping Name(s): Chloroacetic acid, solid (USDOT & IMO)

Synonyms and Tradenames: Acetic acid, chloro-; Chloracetic acid; MCAA; Chloroethanoic acid; MCA; Monochloracetic acid; Monochloroethanoic acid; Monochloroacetic acid.

CAS Registry No: 79-11-8

Chemical Formula: $ClCH_2COOH$

Constituent Components (% each): Greater than 97.5% pure.

UN/NA Designation: UN1751

IMO Designation: 6.1

RTECS Number: AF8575000

NFPA 704 Hazard Rating: 3 (Health): 1 (Flammability): 0 (Reactivity)

Physical Form as Shipped: Solid

Physical Form as Released: Solid

Color of the Shipped Material: Colorless to white to light brown crystals

Odor Characteristics: Vinegar odor

Reportable Quantity: See appendix I

Common Uses: Herbicide, preservative, disinfectant, mfg. of various dyes and other chemicals. Minor use as an intermediate to produce glycolic acids and their esters, caffeine and barbiturates and other pharmaceuticals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHLOROACETIC ACID, SOLID

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.15 mg/m^3; also reported as .045 ppm (unspecified) and 23.7 mg/m^3 (irritation)

Unusual Hazards: Corrosive and toxic combustible solid. Products of combustion are of special concern.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat or fire; contact with incompatible materials; entry to sewers or confined spaces; inhalation, ingestion or direct physical contact. May ignite combustibles such as wood, paper, oil, etc.

HEALTH HAZARDS

Potential Health Hazards: The major hazard of chloroacetic acid is from direct physical contact or ingestion of the solid. Note, however, that any dust in air will pose an inhalation hazard and that highly irritating and/or toxic gases may be generated in fires.

Hazards of Skin or Eye Contact: Chloroacetic acid may cause severe irritation and burns of the skin which may only become apparent several hours after contact. The product is readily absorbed through the skin and is highly toxic by this route of exposure. Burns result in marked fluid and electrolyte loss and death may follow if too much of the skin is exposed. Contact with the eyes may result in severe irritation and burns.

Hazards of Inhalation: Inhalation of chloroacetic acid may cause irritation and tissue damage to mucous membranes, the upper respiratory tract and the lungs. Excessive exposures may result in pulmonary edema (which may be delayed in onset) and potentially severe consequences. Various symptoms of exposure may include a burning sensation, coughing, wheezing, shortness of breath, headache, nausea and vomiting.

Hazards of Ingestion: Ingestion of chloroacetic acid may cause interference with essential enzyme systems, burns of the mouth or stomach and potentially severe internal damage, perforation, peritonitis and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 8%

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible solid. Will burn but difficult to ignite.

Hazardous Combustion Products: May include highly toxic and/or irritating hydrogen chloride, phosgene and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Stable, generally not explosive according to available data.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

FIRST AID

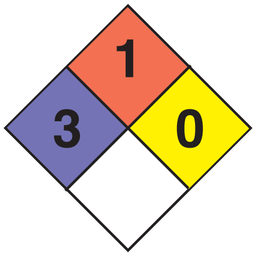
Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not

1751

CHLOROACETIC ACID, SOLID

Division 6.1 (Poisonous Material)



breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if burning or irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, lifting the upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of milk or water immediately. Do not attempt to make the victim vomit without seeking medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Water spray (fog), dry chemical, carbon dioxide, or foam.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water to protect exposures or prevent containers from failing. Do not flood spill material with water since it does not significantly reduce the pH. Fight fire from maximum distance. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Dike fire control water for proper disposal since it may contain toxic gases.

SPILL RESPONSES

General Information: Chloroacetic acid is a highly toxic solid that may cause environmental contamination. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Prevent substance from entering sewers, waterways and confined spaces. Underflow dams are not an effective means to dike material since it mixes with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

CHLOROACETIC ACID, SOLID

Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Chloroacetic acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of chloroacetic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind to unprotected personnel. Continually monitor for any conditions that would alter the situation.

TECHNIQUE

PROTECTION FROM THE WIND . . . If necessary, cover solid chloroacetic acid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chloroacetic acid, dust or mist, in air may reduce airborne concentrations.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

COVER MATERIAL . . . If necessary, cover solid chloroacetic acid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

TECHNIQUE

MECHANICAL REMOVAL . . . Material and any soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

CHLOROACETIC ACID, SOLID

Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where material is likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may become mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Protect solid from becoming wet. Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques.

CHLOROACETIC ACID, SOLID
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

AERATION . . . Water containing dissolved materials may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging, a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

CHLOROACETIC ACID, SOLUTION

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Chloroacetic acid is a colorless to light-yellow or amber liquid with a strong odor resembling vinegar. It is used as a herbicide, preservative, disinfectant and in the manufacturing of various dyes and other chemicals. Its minor uses are as an intermediate to produce glycolic acids and their esters, caffeine and barbiturates and other pharmaceuticals. It will dissolve rapidly in water generating some amount of heat. It is corrosive to cast iron, steel, some stainless steel, copper, brass, aluminum, silver and lead. It is stable although it will react with alkalis, strong oxidizing agents, strong reducing agents and active metals. It is heavier than water. Its vapors are heavier than air, but have a low vapor pressure. A flash point of 126°C (259°F) or greater indicates that the material is difficult to ignite unless substantially preheated.

Toxicity of the product is mostly related to its highly corrosive action on bodily tissues and it is important to note that the substance has a low vapor pressure. It is due to this characteristic that the hazards to health are mainly limited to direct skin or eye contact and ingestion, and not inhalation. However, inhalation is still a hazard if occurs. It is important to also note that severe burns may occur with contact to chloroacetic acid in the molten state. Products of decomposition or combustion are of special concern and include highly toxic and/or irritating hydrogen chloride, phosgene, carbon dioxide and carbon monoxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, carbon disulfide, carbon tetrachloride, chloroform, diethyl ether, ethanol, ether and methanol.
Specific Gravity: 1.41, 1.58 (both reported)
Vapor Density: 3.26
Boiling Point: 188-190°C (370.4-374°F) varies on concentration.
Melting Point: 61-63°C (141.8-145.4°F) varies on concentration.
Freezing Point: See melting point
Molecular Weight: 94.50
Heat of Combustion: Unavailable
Evaporation Rate (Butyl Acetate=1): 1
Vapor Pressure: low
Flash Point: 126-150°C (259-302°F) varies on concentration.
Autoignition Temperature: 470°C (878°F), also reported to be greater than 500°C (932°F)
Burning Rate: Unavailable
Flammable Limits: 8%(LEL) - Unavailable (UEL)
Stability: Stable
Polymerization Potential: Will not occur
pH: 1.93 (.1M Solution)
Corrosiveness: Corrosive to cast iron, steel, some stainless steel, copper, brass, aluminum, silver and lead.
Reactivity and Incompatibility: Reacts with alkalis, strong oxidizing agents, strong reducing agents and active metals.
Reactivity with Water: No reaction.
Other Characteristics: Pure chloroacetic acid exists in 4 crystalline forms (alpha, beta, gamma and delta). The alpha form is most stable and is most widely used in industry.

IDENTIFICATION

Shipping Name(s): Chloroacetic acid, solution (USDOT & IMO); Chloroacetic acid, molten (USDOT & IMO)
Synonyms and Tradenames: Acetic acid, chloro-; Chloracetic acid; MCAA; Chloroethanoic acid; MCA; Monochloracetic acid; Monochloroethanoic acid; Monochloroacetic acid.
CAS Registry No: 79-11-8
Chemical Formula: $ClCH_2COOH$
Constituent Components (% each): Varies below 97.5% pure.
UN/NA Designation: UN1750 (Solution); UN3250 (Molten)
IMO Designation: 6.1
RTECS Number: AF8575000
NFPA 704 Hazard Rating: 3 (Health): 1 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid or molten
Physical Form as Released: Liquid or molten
Color of the Shipped Material: Colorless to light-yellow or amber liquid
Odor Characteristics: Vinegar odor
Reportable Quantity: See appendix I
Common Uses: Herbicide, preservative, disinfectant, mfg. of various dyes and other chemicals. Minor use as an intermediate to produce glycolic acids and their esters, caffeine and barbiturates and other pharmaceuticals.

CHLOROACETIC ACID, SOLUTION

Division 6.1 (Poisonous Material)

*Also 3250

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.15 mg/m^3; also reported as .045 ppm and 23.7 mg/m^3 (irritation)

Unusual Hazards: Corrosive and toxic combustible liquid. Products of combustion are of special concern.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat or fire; contact with incompatible materials; inhalation, ingestion or direct physical contact. May ignite combustibles such as wood, paper, oil, etc. Contact with molten material.

HEALTH HAZARDS

Potential Health Hazards: Due to the low vapor pressure of chloroacetic acid, the major hazard is from direct contact and ingestion. Highly irritating and/or toxic gases may be generated in fires. Thermal burns may result from contact with the molten material.

Hazards of Skin or Eye Contact: Chloroacetic acid may cause severe irritation and burns of the skin which may only become apparent several hours after contact. The product is readily absorbed through the skin and is highly toxic by this route of exposure. Burns result in marked fluid and electrolyte loss and death may follow if too much of the skin is exposed. Contact with the eyes may result in severe irritation and burns.

Hazards of Inhalation: Inhalation of chloroacetic acid may cause irritation and tissue damage to mucous membranes, the upper respiratory tract and the lungs. Excessive exposures may result in pulmonary edema (which may be delayed in onset) and potentially severe consequences. Various symptoms of exposure may include a burning sensation, coughing, wheezing, shortness of breath, headache, nausea and vomiting.

Hazards of Ingestion: Ingestion of chloroacetic acid may cause interference with essential enzyme systems, burns of the mouth or stomach and potentially severe internal damage, perforation, peritonitis and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 8%

Upper Flammable Limit: Unavailable

Behavior in Fire: Although chloroacetic acid will not readily ignite, it will burn if exposed to sources of heat and flame.

Hazardous Combustion Products: May include highly toxic and/or irritating hydrogen chloride, phosgene and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Moderate, however containers exposed to prolonged heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

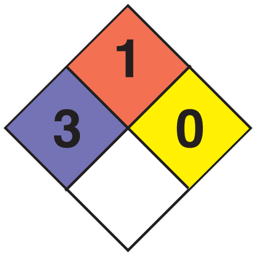
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

1750 *

CHLOROACETIC ACID, SOLUTION

Division 6.1 (Poisonous Material)



*Also 3250

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if burning or irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, lifting the upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of milk or water immediately. Do not attempt to make the victim vomit without seeking medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Water spray (fog), dry chemical, carbon dioxide, or foam.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. Use water to protect exposures or prevent containers from failing. Do not flood spill material with water since it does not significantly reduce the pH. Fight fire from maximum distance. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain toxic gases.

SPILL RESPONSES

General Information: Chloroacetic acid is a toxic liquid that may cause environmental contamination. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Underflow dams are not an effective means to dike material since it mixes with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

CHLOROACETIC ACID, SOLUTION
Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Chloroacetic acid is not expected to evolve large amounts of hazardous airborne contaminants. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

BURIAL . . . Under appropriate conditions, hot molten chloroacetic acid may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of vapors or fumes. Once solidified it can be removed by mechanical means.

CONSEQUENCE

An additional quantity of sand, earth or similar material will become contaminated.

MITIGATION

Consult qualified experts. Consider adding water as necessary to surface of covered material to cool spilled product.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

CHLOROACETIC ACID, SOLUTION
Division 6.1 (Poisonous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water via a processing system constructed on land.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CHLOROACETIC ACID, SOLUTION

Division 6.1 (Poisonous Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralization agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

January 1988

CHLOROBENZENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Chlorobenzene is a colorless liquid with a sweet, almond like, and aromatic odor. It is used to make pesticides, dyes, and other chemicals and has applications as a solvent and in heat transfer, dry cleaning, and color printing processes. Barely soluble in water and somewhat heavier, it can be expected to sink to the bottom of a water body and dissolve very slowly. Its flash point of 84°F indicates that it can be easily ignited in warm ambient temperature conditions. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 9.2 pounds per gallon.

Chlorobenzene is considered stable in normal transportation. It does not react with water or other common materials but is reactive with a wide variety of chemicals. Mixtures with silver perchlorate, alkali and alkaline earth metals, peroxides or strong reducing agents may be explosive. The product can be considered moderately toxic by all routes of exposure. Products of combustion may include toxic gases, such as hydrogen chloride, phosgene, and carbon monoxide.

Downwind evacuation should be considered on a case by case basis if chlorobenzene is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.049 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, benzene, ether, and most organic solvents.
Specific Gravity (Liquid): 1.106 at 68°F (20°C)
Boiling Point: 270°F (132°C) at 1 atm.
Melting Point: –49.4°F (–45.2°C)
Freezing Point: –50.1°F (–45.6°C)
Molecular Weight: 112.56
Heat of Combustion: –6700 cal/g (est.)
Vapor Pressure: 10 mm Hg (0.193 psia) at 72°F (22.2°C)
Flash Point: 84°F (29°C), closed cup; 97°F (36.1°C), open cup.
Autoignition Temperature: 1099–1184°F (593–640°C)
Burning Rate: 4.6 mm/minute (est.)
Stability: Stable
Corrosiveness: Will attack some forms of plastics, rubbers, and coatings.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with silver perchlorate, dimethyl sulfoxide, strong oxidizers, cyanides, mercaptans, other organic sulfides, mineral acids, azo and diazo compounds, hydrazines, caustics, nitrides, alkali and alkaline earth and certain elemental metals, peroxides, and strong reducing agents.

IDENTIFICATION

Shipping Names: Chlorobenzene (USDOT and IMO)
Synonyms and Tradenames: Phenylchloride; monochlorobenzene; benzene chloride; chlorobenzol; chlorbenzene; chlorbenzol; MCB.
Chemical Formula: C_6H_5C1
Constituent Components(% each): Technical grade is 99.5% pure.
49 STCC: 49 091 53
UN/NA Designation: UN1134
IMO Designation: 3.3, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Mild amine odor; sweet, almond like; mildly aromatic.
Common Uses: Mfg. of pesticides, dyes, phenol, aniline, chloronitrobenzene; solvent; used in heat-transfer, dry cleaning, and color printing processes.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CHLOROBENZENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

***Threshold Odor* Concentration:** 0.21 ppm

Unusual Hazards: Flammable liquid with toxic combustion products.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): *75* ppm over each 8 hours of a *40* hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; runoff to sewers or water; incompatible materials; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of vapors in air. Physical contact and ingestion should also be avoided. Prolonged or repeated exposure may result in liver, kidney, or lung damage.

Hazards of Skin or Eye Contact: Repeated or prolonged contact of liquid chlorobenzene with the skin may cause irritation or burns. Contact with the eyes may cause temporary irritation.

Hazards of Inhalation: Vapors of chlorobenzene irritate the eyes, nose, and throat at *200* ppm in air. Inhalation of higher concentrations may cause narcosis and depression of the central nervous system with symptoms including coughing, dizziness, drowsiness, incoordination, and unconsciousness. Other possible symptoms may include twitching, red urine, cyanosis, deep rapid breathing, and weak irregular pulse. Extreme exposures may cause liver damage and possibly death.

Hazards of Ingestion: Ingestion may result in pallor, cyanosis, coma, vascular paralysis, and heart failure. Symptoms may be delayed several hours.

FIRE HAZARDS

Lower Flammable Limit: 1.3%

Upper Flammable Limit: 7.1%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel some distance to a source of ignition and flash back. There is some potential that containers may rupture violently in fire.

Hazardous Combustion Products: May include toxic hydrogen chloride, phosgene, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: 1.8%

Upper Explosive Limit: 9.6%

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire. Contact with silver perchlorate, alkali, alkaline earth metals, peroxides, or strong reducing agents may result in formation of explosive mixtures.

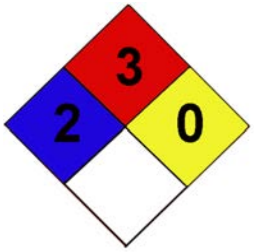
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Some compatible materials may include polyethylene, polyurethane, nitrile-butadiene rubber and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2400 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (2400 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use of limitations of these devices.

1134

CHLOROBENZENE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes and upper respiratory tract or signs of narcosis due to vapor exposure. Irritation of the skin or eyes due to direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if irritation persists after washing of skin.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, carbon dioxide, dry chemical, foam. Water may be ineffective except as a blanket.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Do not extinguish burning cargo unless flow can be stopped safely. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of chlorobenzene may result in rupture or explosion of boilers or industrial process equipment. Eliminate ignition sources. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that chlorobenzene is a flammable and relatively toxic substance.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Chlorobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of chlorobenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Chlorobenzene spills may expose downwind areas to toxic or flammable concentrations, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CHLOROBENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY ... . Water fog or spray applied to chlorobenzene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of chlorobenzene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of chlorobenzene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER APPLICATION . . . Application of water to the surface of contained liquid pools may reduce emissions of vapors. Water should float on top of chlorobenzene.

CONSEQUENCE

Addition of water will increase the volume of contaminated liquid requiring containment.

MITIGATION

Contain water and spilled product and remove as soon as possible. Be alert to conditions that

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Chlorobenzene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained chlorobenzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use compatible equipment. Monitor or control temperature of product.

CHLOROBENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment. ,

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to .remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

CHLOROBENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 1992

CHLOROBUTANES
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Chlorobutane, which may also be shipped under the name "n-butyl chloride", is a fairly volatile, colorless, flammable liquid with an odor variously described as sharp, objectionable, pungent, and resembling either ether or chlorine. It is practically insoluble in water and lighter, so may be expected to form a floating surface slick on water that evaporates at an appreciable rate and dissolves very slowly. The product is used as a solvent, as a veterinary medicine, and for making a variety of other organic chemicals. Its lowest reported flash point of 13°F indicates that it can be easily ignited under a wide range of ambient temperature conditions. Vapors are somewhat heavier than air, may possibly accumulate and persist in low lying areas, and may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.35 pounds per gallon.

Chlorobutane is stable in normal transportation. It slowly hydrolyzes in the presence of moisture or water to form corrosive hydrochloric acid, may react in a hazardous fashion with aluminum and possibly other chemically active metals, is expected to react with a variety of other chemicals, and may attack some forms of plastics, rubber, and coatings. Any hydrochloric acid formed may corrode various metals while evolving flammable and potentially explosive hydrogen gas. Toxicity of chlorobutane is generally low to moderate by all routes of exposure but its products of combustion or thermal decomposition may include, but not be limited to, highly toxic and corrosive substances such as carbon monoxide, carbon dioxide, hydrogen chloride, hydrochloric acid, and phosgene. These substances may be more dangerous than the vapors of chlorobutane itself.

Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, and weather conditions if chlorobutane is leaking from its container but not on fire. Products of combustion or thermal decomposition include several that are highly toxic and may also provide cause for consideration of a such actions if evolved into the atmosphere in significant quantities. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

Due to various factors, the data and information found for this substance were limited in detail and contained various shortcomings.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 660 ppm at 53.6 or 54.5°F (12 or 12.5°C). Some sources report 0.11% by weight at an unspecified temperature.
Solubility in Other Chemicals: Soluble in alcohol and ether.
Specific Gravity (Liquid): 0.8862 - 0.8875 at 68°F (20°C)
Boiling Point: 173.1 - 173.5°F (78.4 - 78.6°C) at 1 atm is most commonly reported.
Melting Point: - 189.6 to - 189.0°F (- 123.1 to - 122.8°C)
Freezing Point: See melting point
Molecular Weight: 92.57
Heat of Combustion: Not available
Vapor Pressure: 80.1 or 81 mm Hg (1.5483 or 1.5656 psia) at 68°F (20°C); 200 mm Hg (3.8658 psia) at 104°F (40°C).
Flash Point: 13 to 20°F (- 10.6 to -6.7°C), closed-cup; 15 to 23°F (- 9.4 to - 5.0°C), open-cup.
Autoignition Temperature: 464 or 860°F (240 or 460°C); reported values vary.
Burning Rate: Not available
Stability: Stable in normal transportation
Corrosiveness: May react hazardously with aluminum and possibly magnesium according to various authorities, which also suggests the possibility of reactions with other active metals. Forms hydrochloric acid in the presence of water or moisture. May attack some forms of plastics, rubber, and coatings.
Reactivity with Water: Slowly Hydrolyzes to form hydrochloric acid. The reaction is not reported to be rapid, vigorous or violent.
Reactivity with Other Chemicals: Besides reactivity with metals discussed in the "Corrosiveness" section, the material is simply reported to be incompatible with oxidizing materials which may possibly cause a fire or explosion.

IDENTIFICATION

Shipping Names: n-Butyl chloride; chlorobutanes
Synonyms and Tradenames: Butane, 1-chloro; normal-butyl chloride; 1-chlorobutane; and n-propylcarbinyl chloride. Be advised that the shipping name "chlorobutanes" may also be used for a variety of isomers, including isomers of n-butyl chloride.
Chemical Formula: $CH_3CH_2CH_2CH_2C1$
Constituent Components (% each): Limited available data suggest the commercial product is usually 99% or more pure.
49 STCC: 49 081 15
UN/NA Designation: UN1127
IMO Designation: 3, flammable liquid
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sharp, objectionable; pungent, unpleasant; like ether or chlorine according to various authorities, though a resemblance to ether seems more likely if the product has not been exposed to water or moisture.
Common Uses: Used as a solvent and to make a variety of organic chemicals; used as a medicine to expel or destroy intestinal worms in veterinary medicine.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CHLOROBUTANES
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: One authority reports an absolute perception limit of 8.82 ppm; a 50% recognition level of 13.3 ppm; and a 100% recognition level of 16.7 ppm in air.

Unusual Hazards: Volatile flammable liquid with vapors that may be heavier than air and persist in low areas. Products of combustion or thermal decomposition appear more hazardous than the vapors of chlorobutane itself to downwind populations. The product hydrolyzes in the presence of water or moisture to form hydrochloric acid which is corrosive and may produce flammable and potentially explosive hydrogen gas in contact with many common metals. Chlorobutane is reported to be dangerously reactive with aluminum according to at least one authority and may also possibly be reactive with other chemically active metals.

Short Term Exposure Limit (STEL): Not established for chlorobutane or similar substances.

Time Weighted Average (TWA) Limit: Not established for chlorobutane. The TWA limit for ethyl chloride is 1000 ppm over each 8 hours of a 40 hour work week (ACGIH, 1991-92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; contact with hot surfaces that may result in thermal decomposition of the product.

HEALTH HAZARDS

Public Health Hazards: Major hazard, in the absence of fire or high temperatures, is from the high concentrations of chlorobutane vapors that may be present in air in the spill area and over some distances downwind. Direct contact and ingestion should also be avoided.

Hazards of Skin or Eye Contact: High concentrations of chlorobutane vapors in air may cause slight irritation of the eyes. Contact of the eyes with liquid chlorobutane may cause irritation with symptoms including discomfort, lacrimation, increased blinking, excess redness, and possible swelling. Contact of the skin with the liquid may cause mild irritation evidenced as mild local redness. Prolonged contact, as due from clothing wet with the liquid, may cause more severe irritation with symptoms including marked redness and possible local swelling. One authority adds that the liquid may cause a rash due to removal of skin oils, which indicates that prolonged or repeated contact may also possibly result in drying and cracking of the skin. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury. (Note: It appears logical to be more careful with chlorobutane that has been in prolonged contact with moisture or water. The hydrochloric acid that forms may possibly cause more severe irritation or burns to bodily tissues than described above.)

Hazards of Inhalation: Limited available data indicate that the vapors of chlorobutane may cause irritation of the nose and throat. High concentrations in air may cause dizziness, nausea, vomiting, lightheadedness, and unconsciousness. Very high levels may result in death. Be advised that substances similar to chlorobutane are known to be narcotics and central nervous system depressants which variably cause drowsiness, staggering gait, irregular heartbeat, tremors, confusion, difficulty in speaking, talkativeness, personality changes, loss of memory, blurred or double vision, painful abdominal cramps, diarrhea, incoordination, pulmonary congestion and edema, and/or effects on the liver and kidneys.

Hazards of Ingestion: Liquid chlorobutane is of low to moderate toxicity by ingestion. Symptoms of ingestion are reported to include nausea, vomiting, abdominal discomfort and cramping, diarrhea, central nervous system depression with many of the effects associated with inhalation, and possibly death in extreme cases.

FIRE HAZARDS

Lower Flammable Limit: 1.8%

Upper Flammable Limit: *10.1%*

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors may be heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in a fire and possibly rocket.

Hazardous Combustion Products: Thermal decomposition of chlorobutane at high temperatures or its combustion are reported to produce highly toxic and/or corrosive substances including but not limited to carbon monoxide, hydrogen chloride, hydrochloric acid, and phosgene. These substances may be more hazardous than the vapors of chlorobutane itself.

1127

CHLOROBUTANES
Class 3 (Flammable Liquid)

EXPLOSION HAZARDS

Lower Explosive Limit: Not available
Upper Explosive Limit: Not available
Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in a fire and possibly rocket. Contact with strong oxidizing agents, certain other chemicals, or certain metals may result in an explosion under appropriate conditions.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus may be necessary to prevent contact with high concentrations of gases or fumes generated by thermally decomposing or burning n-butyl chloride. Compatible materials for n-butyl chloride itself, according to highly respected authorities, may include polyvinyl alcohol (best) and Viton (fair to good). A major manufacturer of the product indicates that polyvinyl chloride (PVC) may also be suitable for use.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent) for fire fighting or in spill emergency situations.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; dizziness, drowsiness, confusion, nausea, vomiting, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Have victim lean forward with head below hips to reduce risk of aspiration into lungs and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, foam. Note that water may be ineffective and that n-butyl chloride will slowly hydrolyze in its presence to form corrosive hydrochloric acid. Be advised that authorities disagree as to whether regular or alcohol foam should be used; it is likely that both are effective to some degree.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with dense fumes or smoke resulting from burning or decomposing chlorobutane may be anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture, possibly rocket, and suddenly release massive amounts of product when exposed to high heat such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

CHLOROBUTANES
Class 3 (Flammable Liquid)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take the volatile and flammable nature of the substance and its heavier than air vapors into account while planning the response. Ensure that chlorobutane is not handled in or exposed to metals (particularly aluminum) with which it may be reactive. Note that the product slowly forms corrosive hydrochloric acid in the presence of moisture or water. Hydrochloric acid will evolve flammable and potentially explosive hydrogen gas while corroding various metals.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Chlorobutane discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chlorobutane vapors in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain small amounts (if any) of chlorobutane and possibly hydrochloric acid.

MITIGATION

Contain contaminated water where deemed necessary and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of chlorobutane vapors into the atmosphere. (Note: Authorities disagree as to whether regular or alcohol type foams are best suited for use with this product; both may be effective to some degree.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

CHLOROBUTANES
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid chlorobutane or contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods**.**

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. A hazardous reaction may take place if chlorobutane is handled in equipment constructed of aluminum or possibly other chemically active metals.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded, or may initiate a hazardous reaction. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

CHLOROBUTANES
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid chlorobutane is only very slightly soluble in water and lighter, so may be expected to form a floating and potentially flammable surface slick that dissolves far less slowly than it evaporates from the water surface.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS... Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh may absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose a risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING. . . Oil spill skimming devices may be deployed to recover floating liquid chlorobutane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose a risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

CHLOROBUTANES
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with chlorobutane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

CONTAINMENT DIKES . . . Where deemed necessary, water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Where deemed necessary, addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. [Note: Although no specific reference was found to indicate that chlorobutane is efficiently removed from water by the cited sorbents, it is expected that this response may be effective based on data for similar materials (ethyl chloride, e.g.)]

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved chlorobutane may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

NEUTRALIZAT10N . . . Where deemed necessary, application of a suitable neutralization agent to the contaminated water may reduce environmental hazards, particularly and especially if significant quantities of hydrochloric acid have formed due to prolonged contact of chlorobutane with water.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating contaminated water via a processing system constructed on land.

September 2000

CHLORODIFLUOROMETHANE

Division 2.2 (Non-Flammable Gas)

GENERAL INFORMATION

Chlorodifluoromethane is essentially a nonflammable colorless gas that is shipped under pressure as a liquid and has a very faint ethereal odor resembling carbon tetrachloride. It is used as a refrigerant, low-temperature solvent, and intermediate in making Teflon. Although it is slightly soluble in water and heavier, its boiling point of -40.9°F indicates that little will dissolve if the product is spilled into water. All spills on land or water may generate relatively large amounts of heavier than air vapors that may appear white at first and persist in pits, hollows, and depressions. Containers of chlorodifluoromethane may rupture due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 11.8 pounds per gallon near its boiling point temperature.

Chlorodifluoromethane does not react with water or many other common materials and is stable in normal transportation. It is reactive with certain metals, however, and will slowly decompose in the presence of rust and moisture. Toxicity of the product is relatively low, but it may be present in air in very high concentrations, and contact with cold liquid or gas may result in frostbite. Products of decomposition at high temperatures are toxic and irritating and may include fluorine and phosgene.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.3 g/100 g water at 77°F (25°C)

Solubility in Other Chemicals: Soluble in acetone, chloroform, and diethyl ether.

Specific Gravity (Liquid): 1.194

Vapor Density: 3.0

Boiling Point: -42°F (-41°C) at 1 atm.

Melting Point: -230.8°F (-146°C)

Freezing Point: -230.8°F (-146°C)

Molecular Weight: 86.48

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): >1

Vapor Pressure: 10 atm (146.9 psia) at 75.2°F (24°C)

Flash Point:Not flammable.

Autoignition Temperature: One source reports 1170°F (631°C)

Burning Rate: Not flammable

Flammable Limits: Not flammable

Stability: Stable

Polymerization Potential: Will not occur.

pH: Neutral

Corrosiveness: Not corrosive, but may react with some metals (see below).

Reactivity with Water: No reaction

Reactivity and Incompatibility: Slowly decomposes in the presence of rust and moisture. Reacts with alkali and alkaline earth metals and powdered aluminum, zinc, magnesium, beryllium, sodium, potassium, etc.

IDENTIFICATION

Shipping Name(s): Chlorodifluoromethane or Refrigerant gas R22 (USDOT & IMO)

Synonyms and Tradenames: Monochlorodifluoromethane; Difluorochloromethane; Difluoromonochloromethane; Algeon 22; Algofrene type 6; Aroton 4; Eskimon 22; Electro CF 22; F-22; Freon® 22; Frigen 22; FC-22; Genetron® 22; Isotron 22; R-22; Ucon 22.

CAS Registry No.: 75-45-6

Chemical Formula: $ChClF_2$

Constituent Components (% each): 99 - 100% pure

UN/NA Designation: UN1018

IMO Designation: 2.2, Non-flammable gases

RTECS Number: PA6390000

NFPA 704 Hazard Rating: 2(Health): 0(Flammability): 1(Reactivity)

Physical Form as Shipped: Compressed iquefied gas

Physical Form as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Faint, ethereal, sweet, pungent, like carbon tetrachloride.

Reportable Quantity: See appendix I.

Common Uses: Refrigerant; low-temperature solvent; mfg. Teflon; former aerosol propellant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHLORODIFLUOROMETHANE

Division 2.2 (Non-Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Spills may result in large quantities of heavier than air vapors. Product boils at -42°F (-41°C) and may cause frostbite upon contact.

Short Term Exposure Limit (STEL): 1250 ppm (4375 mg/m^3)

Time Weighted Average (TLV-TWA): 1000 ppm (3500 mg/m^3)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to water bodies; inhalation or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations in air that may be present in the spill area and downwind. Contact with cold product or its containers may cause frostbite.

Hazards of Skin or Eye Contact: Contact with liquid chlorodifluoromethane or gas directly discharged from a container may result in mild to severe frostbite. Severe frostbite may affect deep tissue and may result in gangrene.

Hazards of Inhalation: Very high concentrations of chlorodifluoromethane in air may cause narcosis and other effects including lightheadedness, giddiness, shortness of breath, drowsiness, nausea, heart irregularities, unconsciousness, and possibly death. Death results from 30-40% concentrations in air in animal experiments; 20% causes narcosis; 10% causes stimulation and then depression. Various organs of the body may be affected at even lower concentrations.

Hazards of Ingestion: Ingestion is unlikely but would minimally result in frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization.

Hazardous Decomposition Products: Decomposition products may include carbon monoxide, carbon dioxide, hydrogen fluoride, hydrogen chloride gas, phosgene gas and traces of carbonyl halides.

EXPLOSION HAZARDS

Explosive Limit: Not flammable

Explosive Potential: Containers may rupture violently in fire due to overpressurization. Reacts violently with powdered metals such as aluminum and zinc, causing fire and explosion hazard. Attacks magnesium and its alloys.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

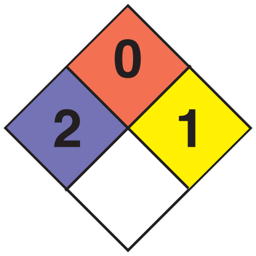
Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact with the spilled product and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Viton® is reported to provide more than 8 hours of protection.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge may suffice.

1018

CHLORODIFLUOROMETHANE

Division 2.2 (Non-Flammable Gas)



FIRST AID

Nonspecific Symptoms: Frostbite or symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Reports vary regarding removal of clothing, due to possibility of frostbite. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: Get medical attention immediately. Have victim drink lukewarm water, if victim is conscious.

FIRE RESPONSE

Extinguishing Agents: Use extinguishing media appropriate for surrounding fire.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the low boiling point of the product into account while planning the response. Beware of possible heavy gas concentrations in pits, hollows, and depressions.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chlorodifluoromethane vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact pools of liquid chlorodifluoromethane as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of chlorodifluoromethane from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

CHLORODIFLUOROMETHANE

Division 2.2 (Non-Flammable Gas)

TECHNIQUE

FOAM . . . Application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of chlorodifluoromethane vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching in moist soil, possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may confine spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Confined chlorodifluoromethane may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders. (Note: Most residue will rapidly evaporate.)

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

CHLORODIFLUOROMETHANE

Division 2.2 (Non-Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination. (Note: Little of the spilled product will dissolve while it is simultaneously sinking and boiling in water. Water spill responses may only be required in special cases. Consult qualified experts for advice.)

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

This page may be used for notes.

August 1997

CHLOROFORM

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Chloroform is a volatile colorless liquid with a pleasant, sweet, pungent odor resembling ether. It is used mainly as a starting material in the production of chlorodifluoromethane, which is used as a refrigerant, and aerosol propellant, but has many other uses also. It is slightly soluble in water and heavier, so may be expected to sink and dissolve at a slow rate. The product is not flammable, but due to its volatility, there is some potential that containers may rupture due to overpressurization if exposed to fire or excessive heat for a sufficient time duration. The product weighs approximately 12.4 pounds per gallon. Its vapors are heavier than air and may persist in low areas.

Chloroform does not react with water and is mostly stable in normal transportation. It reacts with a variety of chemicals and some metals however, and may become violently explosive if mixed with both water and strong alkalis. Toxicity of the product is low to moderate in acute exposures, but chloroform may be present in air in high concentrations. NIOSH considers chloroform a potential occupational carcinogen. Products of decomposition at high temperatures include phosgene, chlorine, carbon monoxide, carbon dioxide and hydrogen chloride gases. Phosgene and hydrogen chloride may also be formed (very slowly) if chloroform is exposed to air or light.

If the material is leaking and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.8 g/100g water at 20°C (68°F)
Solubility in Other Chemicals: Soluble in acetone and ligroin. Miscible with benzene, diethyl ether, ethanol, naphtha, fixed oils and volatile oils.
Specific Gravity (Liquid): 1.49 at 20°C (68°F)
Vapor Density (Air=1): 4.36
Boiling Point: 61.2°C (142°F)
Melting Point: See freezing point
Freezing Point: -63.5°C (-82.3°F)
Molecular Weight: 119.38
Evaporation Rate (Butyl Acetate=1): 11.6
Vapor Pressure: 150-160 mm Hg (2.90-3.09 psia) at 20°C (68°F)
Flash Point: Not flammable
Autoignition Temperature: Above 1000°C (1832°F)
Stability: Stable, but may decompose very slowly in presence of air or light to form toxic phosgene and hydrogen chloride.
Polymerization Potential: Will not occur
Corrosiveness: Will corrode iron and certain other metals in the presence of water or at high temperatures. Reactive with some other metals (see below). May attack some plastics, rubber and coatings.
Reactivity and Incompatibility: Reacts with strong alkalis or caustics, oxidizing materials, aluminum, pot metals and its alloys, magnesium, sodium, potassium, acetone, disaline, lithium, nitrogen tetroxide, potassium tert-butoxide, nitromethane, sodium methylate, primary amines, halogens or halogenating agents, perchloric acid and phosphorous pentoxide mixture, mix of methyl alcohols and sodium or potassium hydroxide, and phenols in basic solution.

IDENTIFICATION

Shipping Name(s): Chloroform (USDOT & IMO)
Synonyms and Tradenames: Trichloromethane; Methenyl trichloride; Formyl trichloride; Trichloroform; Methenyl chloride; Methane trichloride; Freon 20; R 20 (refrigerant); CAS Registry No: 67-66-3
Chemical Formula: $CHCl_3$
Constituent Components (% each): Technical grade is 99.5% pure; may contain small amount of ethanol as stabilizer.
UN/NA Designation: UN1888
IMO Designation: 6.1
RTECS Number: FS9100000
NFPA 704 Hazard Rating: 2 (Health): 0 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pleasant, sweet, pungent, like ether.
Reportable Quantity: See appendix I
Common Uses: Mainly used as a starting material in the production of chlorodifluoromethane which is used as a refrigerant and aerosol propellant. Veterinary medicine and anesthetic, grain fumigant, mfg. pharmaceuticals, artificial silk, plastics, floor polishes, cosmetics, fluorocarbons, pesticides and dyes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHLOROFORM
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 200-300 ppm reported often, but one source reports 50 ppm and one 8 ppm.
Unusual Hazards: None.
Short Term Exposure Limit (STEL): 2 ppm
Time Weighted Average (TLV-TWA): None.
Ceiling (C) Limit: 50 ppm
IDLH: 500 ppm
Conditions to Avoid: Inhalation, ingestion and direct physical contact; heat, fire and exposure to air and light; contact with incompatible materials; entry to sewers and water bodies.

HEALTH HAZARDS

Potential Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and some distance downwind. Direct contact and ingestion are also to be avoided. Note that alcoholics may be affected sooner and more severely from chloroform exposure. NIOSH considers chloroform a potential occupational carcinogen.

Hazards of Skin or Eye Contact: Contact with liquid chloroform may cause drying, cracking and inflammation of the skin due to the defatting action of the product. Contact with the eyes may cause immediate burning pain, irritation and transient corneal injury.

Hazards of Inhalation: Chloroform is a relatively potent general anesthetic at higher concentrations in air but is no longer used as such for humans because of the frequency of cardiac arrest during surgery and of delayed death due to liver injury. High concentrations in air may be narcotic and may cause central nervous depression with the symptoms including headache, dizziness, nausea, drowsiness, vomiting, irregular heartbeat, dilation of the pupils, fatigue, mental dullness, unconsciousness and possibly death. Liver and kidney injury may occur. Opinions vary, but it appears that as little as 500 ppm in air (or less) can produce some toxic effects in short-term acute exposures.

Hazards of Ingestion: Ingestion may cause severe burning of the mouth and throat, pain in the chest and abdomen, and vomiting. Depending on the amount swallowed, liver damage, unconsciousness and possibly death may follow. Aspiration of the lungs during vomiting may result in chemical pneumonia according to one manufacturer.

FIRE HAZARDS

Lower Flammable Limit: Not flammable
Upper Flammable Limit: Not flammable
Behavior in Fire: Generally does not burn except in direct contact with flame or high temperature. Containers may rupture in fire due to overpressurization. May evolve toxic vapors and gases upon release.
Hazardous Combustion Products: Decomposes to highly toxic phosgene, hydrogen chloride, chlorine, carbon dioxide and carbon monoxide gases.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture in fire due to overpressurization. Contact with a mixture of water and strong alkalis may result in explosion.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

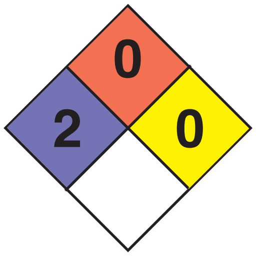
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Compatible materials may include: polyurethane, polyvinyl alcohol, Viton®, and nitrile-butadiene rubber; Tychem®9400 and Barricade® (longer than 8 hours); and, Tychem® 10,000 (323 minutes). Structural firefighting protective clothing does not provide an adequate level of personal protection for this product.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

1888

CHLOROFORM

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Eye or skin irritation; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if burning or irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.) Do not make an unconscious person vomit. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Since chloroform is not flammable, select appropriate agent for protecting fire exposures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear positive-pressure, self-contained breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Chloroform is a volatile and toxic liquid. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Wear appropriate level of personal protective clothing and equipment. Stop flow if it can be accomplished safely. Water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain toxic gases. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be toxic. Underflow dams are not an effective means to dike material since it is heavier than water. As a result, recovery efforts from water borne releases are difficult. Note that it may become explosive if mixed with water and strong alkalis. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

CHLOROFORM

Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

MONITOR THE SITUATION . . . Chloroform may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

TECHNIQUE

COVERAGE WITH WATER . . . The addition of a thin layer of water to the surface of contained liquid pools may slow the release of vapors into the atmosphere. Water will float on top of chloroform if the surface is calm.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Water will be contaminated and will increase the corrosivity and reactivity hazards of chloroform, especially if alkaline materials may be present.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste.

CHLOROFORM
Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

CHLOROFORM
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may spread contaminate.

MITIGATION

Excavate as last resort, unless adverse environmental impacts can be minimized.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottoms sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

CHLOROPICRIN
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Chloropicrin is a colorless to light yellow or green slightly oily nonflammable liquid with intensely irritating vapors having an effect like tear gas at very low concentrations in air. It is actually used as a tear gas, has been used as a poison gas by the military, and has uses in organic synthesis and the making of dyestuffs, fumigants, fungicides, insecticides, and rat poisons. The substance is only slightly soluble in water and heavier, so may be expected to sink to the bottom of a water body and dissolve at a very slow rate. It weighs approximately 13.8 - 14.1 pounds per gallon.

Chloropicrin does not react with water, but is said to be a strong oxidizing agent that reacts violently or can cause fires or explosions in contact with other oxidizers, combustible materials, or reducing agents as well as several other types of chemicals. Chloropicrin is considered stable in normal transportation but has several unusual characteristics relating to stability. Above a critical volume (one source says greater than 30 gallons), chloropicrin can be shock-detonated, particularly when heated. The material decomposes violently at about 234°F when heated or exposed to direct flame, especially in contact with metals, to produce highly toxic gases including phosgene, nitrogen oxides, nitrosyl choride, chlorine, and carbon monoxide. Toxicity of the undecomposed material is very high by all routes of exposure, and chloropicrin vapors in air may be harmful over very considerable downwind distances. The product is incompatible with aluminum and magnesium and their alloys, rubber, PVC, PVDC, and possibly other plastics and coatings.

Downwind evacuation should be considered whenever chloropicrin is leaking from a container. (Note: this guide primarily discusses the properties and hazards of pure chloropicrin except where noted otherwise.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very slightly soluble; about 0.18g/100g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, benzene, and carbon disulfide.

Specific Gravity (Liquid): 1.65-1.66 at 68°F (20°C)

Boiling Point: 233.2-234.1°F (111.8-112.3°C) at 1 atm; may explode if shocked or decompose violently.

Melting Point: – 84.1 to – 83.2°F (– 64.5 to – 64°C)

Freezing Point: See melting point

Molecular Weight: 164.4

Heat of Combustion: Not flammable

Vapor Pressure: 16.9-20 mm Hg (0.327-0.387 psia) at 68°F (20°C); reported values vary.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable during normal transport.

Corrosiveness: Chloropicrin may attack some forms of plastics, rubber, and coatings. It is incompatible with containers or equipment made of aluminum, magnesium or their alloys, rubber, PVC, or PVDC. Mild steel (if dry) and teflon lined equipment is suitable.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Incompatible materials include aniline, sodium hydroxide, sodium methylate, organic amines, strong oxidizers, reducing agents, sulfuric acid, propargyl bromide, and other compounds. See General Information section and Corrosiveness section for additional details.

IDENTIFICATION

Shipping Names: Chloropicrin (USDOT and IMO), chloropicrin mixture (USDOT and IMO)

Synonyms and Tradenames: Trichloronitromethane; nitrochloroform; nitrotrichloromethane; Tri-Clor; Profume A; Picride; Pic-Clor, PS; Chlor-O-Pic; Picfume; Acquinite; Microlysin; Larvacide; Dolochlor; etc.

Chemical Formula: $CC1_3NO_2$ or $C1_3CNO_2$

Constituent Components (% each): Liquid chloropicrin is usually 96% or more pure with remainder mostly water, other halonitroalkanes, and trace of hydrochloric acid. When "absorbed", the liquid is shipped absorbed on dry noncombustible carrier. Mixtures may include methyl bromide, methyl chloride, carbon tetrachloride, trichloroethylene, or other substances.

UN/NA Designation: UN1580 and UN1583

IMO Designation: 6.1, poison, for UN1580 and UN1583; 2.3, poison gas, for others.

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless to light yellow or green, slightly oily liquid. Colorless when pure.

Odor Characteristics: Intensely irritating tear gas odor and effect; penetrating.

Common Uses: Organic synthesis; dyestuffs; fumigants; fungicides; insecticides; rat exterminator; tear gas; military poison gas.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

CHLOROPICRIN

Division 6.1 (Poisonous Material)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1.1 ppm

Unusual Hazards: Highly reactive. Heated material may detonate if shocked while in confinement when present in excess of a critical volume. Vapors are highly toxic, as are decomposition products. Contact with other chemicals or combustible materials may result in fire or explosion.

Short Term Exposure Limits (STEL): 0.3 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 0.1 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major public hazard is from inhalation of the highly toxic vapor concentrations in air that may occur in the spill area and over significant downwind distances. Contact with the skin or eyes by either the liquid or high vapor concentrations in air and ingestion must also be strictly avoided.

Hazards of Skin or Eye Contact: Chloropicrin is a severe irritant having a corrosive action on bodily tissues. Contact of the skin with the liquid may result in redness and chemical burns; skin wounds exposed to the chemical may become septic. Although not specifically addressed in the literature, it is expected that similar or more severe eye effects may be expected.

Hazards of Inhalation: Chloropicrin vapors are highly irritating and toxic. Exposures may result in sore throat, coughing, labored breathing, dizziness, nausea, vomiting, faintness, and severe eye lacrimation. Higher levels may interfere with oxygen transport by blood, and cause bronchitis, irregular heatbeat, asthmatic attack, delayed pulmonary edema, and death. Survivors may suffer permanent damage of the kidney and heart, uremia, asthma, and some degree of sensitization. Concentrations of 0.3-0.37 ppm cause painful eye irritation in 3-30 seconds; 4 ppm is temporarily disabling in a few seconds; 15 ppm is not tolerable for more than a minute; 20 ppm for 1-2 minutes causes bronchial or pulmonary lesions; 298 ppm is lethal in 10 minutes; 119 ppm is lethal in 30 minutes.

Hazards of Ingestion: Chloropicrin is corrosive to the mouth, throat, and digestive tract, and may cause many of the same symptoms of inhalation.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Heated material decomposes violently at 234°F (112°C), especially in contact with metals. Containers may detonate if shocked. Large amounts of highly toxic vapors may be released if container ruptures in fire. Decomposition products are also highly toxic.

Hazardous Combustion Products: Decomposition upon heating or contact with flame produces highly toxic gases including phosgene, nitrogen oxides, nitrosyl chloride, chlorine, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable, but see below

Upper Explosive Limit: Not flammable, but see below

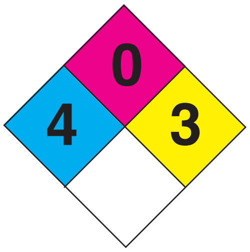
Explosiveness: Above a critical volume, chloropicrin can be shock detonated, particularly when heated. Contact with certain other substances such as combustible materials or propargyl bromide may result in the formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus may be necessary at concentrations above 4 ppm in air to prevent harmful contact. A manufacturer of chloropicrin indicates that suitable materials include neoprene and polyethylene. Another recommends that rubber, PVC, and PVDC materials be avoided.

1580

CHLOROPICRIN
Division 6.1 (Poisonous Material)



See UN/NA Designation for
other ID numbers.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 4 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (4 ppm or less) or an organic vapor cartridge respirator with a full facepiece (4 ppm or less) within the use limitations of these devices. (Note: The above statement is from NIOSH respirator selection tables. However, two sources warn that the usual chemical used in gas masks is ineffective for chloropicrin. Use such devices with great caution if at all.)

FIRST AID

Nonspecific Symptoms: Severe eye lacrimation and irritation or burns of the skin or respiratory tract.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire. Chloropicrin is not combustible.

Extinguishing Techniques: Unusual vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Fight fire from explosion-resistant location. Be alert to the possibility that the container may detonate under fire conditions. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw from area and let fire burn if this is not possible.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or rupture of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the volatility, reactivity, and highly toxic nature of chloropicrin into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent public exposure and to allow vapors or fumes to dissipate. Chloropicrin spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CHLOROPICRIN
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chloropicrin vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of chloropicrin from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of chloropicrin vapors into the atmosphere. (Note: The fact that foam is recommended for use in fighting surrounding fires suggests it may also have value in suppressing vapor evolution from pools of liquid chloropicrin.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER SPRAY APPLICATION . . . Application of water spray to the surface of contained liquid pools may reduce vapor emissions since chloropicrin is heavier than water and of limited solubility.

CONSEQUENCE

Addition of water will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Chloropicrin may be contained by building dikes using soil, sand or other materials .

CONSEQUENCE

Contained chloropicrin may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

CHLOROPICRIN
Division 6.1 (Poisonous Material)

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, vermiculite, or other inert noncombustible materials.

CONSEQUENCE

Once used sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CHLOROPICRIN
Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT . . . Chloropicrin will sink in water and dissolve very slowly (unless accompanied by a wetting agent that speeds dissolution). Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means .

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

CHLOROPRENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Chloroprene is a volatile colorless flammable liquid with a pungent odor resembling ether. It is primarily used to make synthetic rubbers such as neoprene and duprene. It is slightly soluble in water and somewhat lighter, so may be expected to form a floating surface slick that slowly dissolves. Its flash point of –4°F indicates that the product may be easily ignited under a wide range of ambient temperature conditions. Vapors are heavier than air, may accummulate and persist in low areas, and may travel a significant distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 8 pounds per gallon.

Chloroprene does not react with water or many other common materials. It is readily subject to self-polymerization, however, if exposed to heat, light, peroxides, or other oxidizing materials, and this reaction may result in violent rupture of containers. It is a relatively noncorrosive substance but may attack some forms of plastic, rubber, or coatings. Toxicity of the product is moderate to high by the various potential routes of exposure and some authorities consider chloroprene to be a potential human carcinogen in long term occupational exposures. Products of combustion are considered hazardous and may include carbon monoxide and hydrogen chloride gases.

Downwind evacuation should be considered if chloroprene is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble
Solubility in Other Chemicals: Soluble in acetone, benzene, diethyl ether, and other organic solvents.
Specific Gravity (Liquid): 0.9583 at 68°F (20°C)
Boiling Point: 138.9°F (59.4°C) at 1 atm.
Melting Point: –202°F (–130°C)
Freezing Point: – 202°F (–130°C)
Molecular Weight: 88.54
Heat of Combustion: Unavailable
Vapor Pressure: 179 mm Hg (3.46 psia) at 68°F (20°C)
Flash Point: – 4°F (– 20°C), closed cup
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Shipped with inhibitor but may polymerize under conditions described above, even at room temperatures. Maintain below 75°F (23.9°C).
Corrosiveness: May attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Polymerizes in the presence of peroxides or oxidizing materials. Peroxides form in the presence of air. May react with acids.

IDENTIFICATION

Shipping Names: Chloroprene, inhibited (USDOT and IMO)
Synonyms and Tradenames: 2-chloro-1,3-butadiene; chlorobutadiene; 2-chlorobutadiene; beta-chloroprene.
Chemical Formula: $H_2C = CClCH = CH_2$
Constituent Components(% each): Unavailable
49 STCC: 49 072 23
UN/NA Designation: UN1991
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, pungent, like ether
Common Uses: Mfg. synthetic rubber

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CHLOROPRENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

***Threshold Odor* Concentration:** Recognition at 0.11 ppm

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition. Very reactive, may self-polymerize under conditions described in the General Information section.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): (Skin) 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in the spill area and downwind over significant distances. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with liquid chloroprene may result in skin irritation and inflammation as well as temporary hair loss. Some amount may be absorbed through the skin to cause toxic effects. Contact with the eyes may cause irritation, edema of the eyelids, and possible corneal damage.

Hazards of Inhalation: Vapors of chloroprene may cause irritation of the eyes, nose, throat, and respiratory tract. High concentrations in air may result in central nervous system depression, anesthesia, respiratory paralysis, and possibly death in acute exposures. Chronic exposures to high concentrations may result in lung, liver and kidney damage, nervousness and irritability, anemia, low blood pressure, and reproductive system effects.

Hazards of Ingestion: Data unavailable. See hazards of inhalation for some potential effects.

FIRE HAZARDS

Lower Flammable Limit: 4%

Upper Flammable Limit: 20%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapor upon release. Vapors are heavier than air, may accumulate and persist in low areas, and may travel to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in violent polymerization.

Hazardous Combustion Products: May include toxic carbon monoxide and hydrogen chloride gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in the presence of peroxides or other oxidizers.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

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CHLOROPRENE
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, skin, or respiratory system; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of chloroprene may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the significant volatility, flammability, and toxicity of chloroprene into account when planning the response. Note that polymerization may occur if the product is exposed to heat, light, peroxides, or other oxidizers. Note also that heavier than air vapors may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Chloroprene spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chloroprene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of chloroprene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

CHLOROPRENE
Class 3 (Flammable Liquid)

TECHNIQUE

FOAM . . . There is an unconfirmed possibility that firefighting foam applied to the surface of liquid pools may slow the release of chloroprene vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Chloroprene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained chloroprene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, commercial sorbents, or other compatible substances. ,

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

CHLOROPRENE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available. ,

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating chloroprene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

CHLOROPRENE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Peat or commercial sorbent materials compatible with chloroprene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2006

CHLOROSULFONIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Chlorosulfonic acid is a colorless to pale yellow fuming liquid with a sharp, acrid, penetrating, and pungent odor. It is used for making surfactants, dyes, pigments, pharmaceuticals, chemical blowing agents, pesticides, plasticizers, tanning agents, and a variety of other products and chemicals. Although the substance is not itself flammable, it is a strong oxidizer that may ignite combustible organic materials upon contact. In addition, contact with most metals generates flammable and potentially explosive hydrogen gas. The product weighs approximately 14.6 pounds per gallon.

Chlorosulfonic acid reacts violently with water or moisture in air to form a mixture of sulfuric and hydrochloric acids (see separate Guides) while evolving heat and large quantities of dense white acidic fumes. The acid and its fumes are highly corrosive to all bodily tissues and will also attack cast iron, brass, bronze, most non-ferrous metals, and a variety of rubbers and plastics. Reactions with numerous other chemicals may be hazardous. Reactions involving yellow or red phosphorus may be explosive.

If chlorosulfonic acid is involved in an incident, as an immediate precautionary measure, isolate spill or leak area in all directions for at least 150 feet (50 meters) for liquids and at least 75 feet (25 meters) for solids. In the event chlorosulfonic acid is released to the environment, the following evacuation distances should be considered. Note there are different distances for land and water spills due to the reactivity of chlorosulfonic acid with water. For **small** spills on ***land***, isolate area for a radius of 100 feet (30 meters) in all directions with a downwind evacuation of 0.1 miles (0.1 kilometers) for daytime and nighttime. For **small** spills in ***water***, isolate area for a radius of 100 feet (30 meters) in all directions with a downwind evacuation of 0.1 miles (0.1 kilometers) for daytime and 0.4 miles (0.6 kilometers) for nighttime. For **large** spills on ***land***, isolate area for a radius of 100 feet (30 meters) in all directions with a downwind evacuation of 0.2 miles (0.3 kilometers) for daytime and 0.3 miles (0.4 kilometers) for nighttime. For **large** spills in ***water***, isolate area for a radius of 300 feet (90 meters) in all directions with a downwind evacuation of 0.5 miles (0.7 kilometers) for daytime and 1.7 miles (2.8 kilometers) for nighttime. These distances should be adjusted when taking into consideration the amount of material spilled, location, local weather conditions and other factors. If bulk container of chlorosulfonic acid is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. Acid fumes may be heavier than air and collect in low lying areas.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts

Solubility in Other Chemicals: Soluble in liquid sulfur dioxide, nitrobenzene, and halogenated organic solvents containing hydrogen. Slightly soluble in carbon disulfide and other halogenated organic solvents.

Specific Gravity (Liquid): 1.752 at 68°F (20°C)

Vapor Density: 4.0

Boiling Point: 306 to 316.4°F (152 to 158°C) at 1 atm.

Melting Point: –112°F (–80°C)

Freezing Point: –112°F (–80°C)

Molecular Weight: 116.52

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): <1

Vapor Pressure: 1.0 mm Hg (0.019 psia) at 89.6°F (32°C); fuming acid

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Flammable (Explosive) Limits: Not flammable

Polymerization Potential: Will not occur

pH: <1

Corrosiveness: Attacks cast iron, brass, bronze, most other non-ferrous metals, and certain plastics and rubbers. Black iron, glass, 316 SS and Teflon® are resistant.

Reactivity with Water: Reacts violently with formation of sulfuric and hydrochloric acids, and evolution of heat and large quantities of dense white acid fumes.

Reactivity with Other Chemicals: Reacts with organic materials, nitrates, chlorates, metallic powders, carbides, picrates, sulfides, cyanides, fulminates, yellow phosphorus, red phosphorus, sodium hydroxide, ammonium hydroxide, creosote oil, sulfolane, and a wide variety of hydrocarbon derivatives.

IDENTIFICATION

Shipping Names: Chlorosulfonic acid (USDOT); Chlorosulphonic acid (IMO)

Synonyms and Tradenames: Chlorosulfuric acid; Sulfuric chlorohydrin; CSA; Sulfonic acid, Monochloride; Chlorsulfonic acid; Chlorosulphuric acid.

Chemical Formula: $HOSO_2CI$ or HSO_3CI

CAS Registry No.: 7790-94-5

Constituent Components(% each): 98.5–100% pure, remainder is sulfuric acid and free SO_3

UN/NA Designation: UN1754

IMO Designation: 8, corrosive substances

RTECS Number: FX5730000

NFPA 704 Hazard Rating: 4 (Health): 0 (Flammability): 2 (Instability): Water reactive; Oxidizer

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless to pale yellow

Odor Characteristics: Sharp, acrid, penetrating, pungent

Reportable Quantity: See Appendix I

Common Uses: Mfg. of surfactants, dyes, pigments, pharmaceuticals, chemical blowing agents, pesticides, resins, plasticizers, catalysts, tanning agents, saccharin, ion-exchange resins and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHLOROSULFONIC ACID

Class 8 (Corrosive Material)

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and

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** Unavailable

Unusual Hazards: Highly corrosive fuming acid that attacks or reacts with a wide variety of materials. May ignite organic or combustible substances upon contact. Evolves hydrogen in contact with certain metals.

Short Term Exposure Limits (STEL): Unavailable, in contact with water produces hydrochloric and sulfuric acids (see separate Guides)

Time Weighted Average (TLV-TWA): Unavailable, in contact with water produces hydrochloric and sulfuric acids (see separate Guides)

Ceiling (C) Limit: Unavailable, in contact with water produces hydrochloric and sulfuric acids (see separate Guides)

IDLH: Unavailable, in contact with water produces hydrochloric and sulfuric acids (see separate Guides)

Conditions to Avoid: Contact with incompatible materials; runoff to water sources; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Any and all exposures to liquid chlorosulfonic acid or its concentrated vapors or fumes in air may be hazardous to health.

Hazards of Skin or Eye Contact: Contact with liquid chlorosulfonic acid or dense fumes in air may cause severe acid burns or ulcers and ulceration or corrosion to the eyes possibly leading to blindness.

Hazards of Inhalation: Vapors and fumes of chlorosulfonic acid are extremely irritating and corrosive to respiratory passages and may cause inflammation of the upper and lower respiratory tract. High concentrations in air may result in unconsciousness and serious delayed lung damage. Symptoms may include irritation of the nose and throat with sneezing, sore throat, runny nose, difficulty breathing, shortness of breath or pulmonary edema with cough, wheezing, abnormal lung sounds, possibly progressing to bluish discoloration of the skin. Symptoms may be delayed.

Hazards of Ingestion: Ingestion of chlorosulfonic acid may cause burns of the mouth, throat, esophagus and stomach, with severe pain, bleeding, vomiting, diarrhea and collapse of blood pressure. Damage may appear days after exposure. Exposure may be fatal.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Not flammable

Upper Flammable (Explosive) Limit: Not flammable

Behavior in Fire: While chlorosulfonic acid is non-flammable, it is a strong oxidizer and contact with combustible materials may cause fire. Reacts violently with water, spattering acid. Leaks or spills cause dense fumes. May generate large quantities of corrosive fumes and vapors upon release.

Hazardous Decomposition Products: Releases hazardous chlorine, hydrogen chloride, and sulfur dioxide gases when heated.

EXPLOSION HAZARDS

Explosive Potential: Contact with yellow or red phosphorus or certain other chemicals may result in formation of explosive mixtures. When diluted with water, chlorosulfonic acid reacts with most metals to release flammable, potentially explosive hydrogen gas.

1754

CHLOROSULFONIC ACID

Class 8 (Corrosive Material)

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable to prevent contact with high vapor or fume concentrations in air. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 2; Tychem® SL; Tychem® CPF 4; Tychem® Responder®; Tychem® Responder® CSM; Tychem® Responder® CSM; Tychem® Responder®; Tychem® TK; Tychem® ThermoPro.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid canister or an acid cartridge respirator with a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Chlorosulfonic acid may cause irritation or acid burns via all routes of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact do not delay, remove contaminated clothing immediately and wash skin with plenty of cold water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Sources disagree as to whether to give anything to drink, however, there are compelling arguments supporting those that do not recommend administrating water. Get medical attention immediately.

Note to Physician: Ingestion should not be treated solely by dilution with water, since this will generate corrosive substances and large amounts of heat. Gastric lavage may be considered if the patient's condition permits, but corrosive injury may preclude this procedure. Since heat and corrosive reaction products may be generated by the lavage procedure itself, attempt only with great care.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide or flooding quantities of water. Product is not flammable but may ignite combustible materials upon contact. It reacts violently with water.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if not a risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the corrosiveness and reactivity of product with many common metals when deciding on the appropriate response and equipment. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust. Consult a qualified specialist on neutralization techniques, however, some sources suggest neutralizing run-off with lime or soda ash to prevent corrosion of metals and to prevent the formation of hydrogen gas. Chlorosulfonic acid is highly reactive with water. Take into account while planning the response that it is highly corrosive and toxic with heavier than air vapors that may persist for a time in low areas. Be aware that chlorosulfonic acid may ignite organic matter upon contact and that hydrogen gas may be liberated upon contact with certain metals. Use explosion-proof and spark-proof equipment where necessary.

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

OIL/PERLITE APPLICATION . . . Application of white mineral oil (best) to the surface of liquid pools or the addition of perlite (good) or clay (not as good) may reduce emissions of vapors or fumes.

CONSEQUENCE

Addition of these materials will increase the volume of spilled product.

MITIGATION

Contain spilled product and contaminated materials and remove or neutralize as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to chlorosulfonic acid vapors or fumes at a point downwind of the spill may absorb vapors, knockdown fumes or aerosols, and/or accelerate their dispersal in the atmosphere. Do not spray water on pools of liquid chlorosulfonic acid in such cases, as this will increase fume evolution.

CONSEQUENCE

Water runoff may contain chlorosulfonic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid chlorosulfonic acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

CHLOROSULFONIC ACID

Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Chlorosulfonic acid may be contained by building dikes using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained chlorosulfonic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Flammable and potentially explosive hydrogen gas may be evolved in reactions with certain metals.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with absorbent clay, fly ash, cement powder, or other compatible, non-combustible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

CHLOROSULFONIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Flammable and potentially explosive hydrogen gas may be evolved in reactions with certain metals.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

August 1997

CHROMIC ACID SOLUTION

Class 8 (Corrosive Material)

GENERAL INFORMATION

Chromic acid is a dark red or orange, odorless liquid used for chrome plating, the manufacture of inks, paints and other chemicals, process engraving, anodizing and a variety of other purposes. Its percentages for commercial products range from 29% to 60% chromium trioxide. Due to the wide range of percentages, the specific gravity of the solution will change but will always be heavier than water with a low vapor pressure. Also due to the percentage difference, the boiling, melting and freezing points will vary. The boiling point will be higher than water and will increase with higher percentage of chromium trioxide and the melting point will be lower than water and decreased as percentage of chromium trioxide is increased. It is soluble in all proportions with water and may evolve heat. Chromic acid solution has a reported value for pH between 0.2 and 2.0. It is highly corrosive to many metals.

NIOSH lists chromic acid as a potential occupational carcinogen. It is considered hazardous through all routes of entry. Although it is not flammable it contributes to the combustibility of other materials and it can ignite combustible materials due to its powerful oxidizing capability. It is stable although there are numerous incompatible materials. Explosions can occur in contact with reducing agents, acetic acid or anhydrides, acetone, methyl alcohol, phosphorous, potassium, ferricyanide, pyridine and sulfur. Toxic chromium fumes may be emitted if exposed to fire and the decomposing material may form a hot viscous foam. Caution should be used to prevent a steam explosion where water is used to fight fires.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Chromium trioxide anhydrous is soluble in ethanol, ethyl ether, sulfuric and nitric acids.

Specific Gravity: 1.26 for 30% solution; 1.663 for 60% solution.

Vapor Density: Unavailable

Boiling Point: 250°C (482°F)

Melting Point: <-9.4°C (15°F)

Molecular Weight: 118.0

Vapor Pressure: Very low

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Flammable Limits: Not flammable

Stability: Stable

Polymerization Potential: Will not occur

pH: 1.1 in a 1% solution at 25°C (77°F); one source reports 0.2-2.0 for 1% solution

Corrosiveness: Corrosive to steel, iron, copper, bronze, brass, nickel, aluminum, and silver.

Reactivity and Incompatibility: Reacts with heat, acids, phosphorus, arsenic, ammonia, hydrogen sulfide, potassium, sodium selenium, dimethylformamide, alkalis, metals. Avoid contact with oils and greases or any organic or easily oxidizable material. Dangerous ignition hazards occur when contacted with methanol, ethanol, butanol, isobutanol, acetaldehyde, propionaldehyde, butyraldehyde, benzaldehyde, acetic acid, pelargonic acid, ethyl acetate, isopropyl acetate, pentyl acetate, diethyl ether, methyldioxane, dimethyldioxane, acetone and benzylethylaniline. May attack some forms of plastics, rubbers and coatings.

Reactivity with Water: May produce heat.

Other Characteristics: Strong oxidizing agent. Will promote combustion.

IDENTIFICATION

Shipping Name(s): Chromic acid solution (USDOT & IMO)

Synonyms and Tradenames: Chromic (VI) acid; Chromium oxide; Chromium (VI) oxide; Chromium trioxide; Chromium (6+) trioxide; Monochromium oxide; Monochromium trioxide.

CAS Registry No: 1308-14-1

Chemical Formula: H_2CrO_4

Constituent Components (% each): Reports vary from 29% to 60% in water for commercial shipments.

UN/NA Designation: UN1755

IMO Designation: 8

RTECS Number: GB6650000

NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 1 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Dark red or orange solution; one source reports it to be a clear liquid.

Odor Characteristics: Odorless

Reportable Quantity: See appendix I

Common Uses: Wood treating, copper stripping, aluminum anodizing, as a catalyst, refractories, in organic synthesis, photography, metal finishing, plating, leather industries, pigments, and used in many reactions for production or purification of chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHROMIC ACID SOLUTION

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: NIOSH lists chromic acid as a potential occupational carcinogen. It is corrosive to the eyes, skin and respiratory tract. May cause liver damage or be fatal if swallowed, inhaled or absorbed through the skin. Noncombustible, but will accelerate the burning of combustible materials. Powerful oxidizer.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): .001 mgCr(IV)/m^3

Ceiling (C) Limit: .1 mg/m^3

IDLH: 15 mg/m^3 as Cr(IV)

Conditions to Avoid: Contact with incompatible materials, organic materials, heat acids, alkalis, metals, oils, greases or any other easily oxidizable materials. Inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Potential Health Hazards: Routes of exposure are through ingestion, inhalation and eye and skin contact. NIOSH lists chromic acid as a potential occupational carcinogen. It causes severe burns upon contact, kidney failure and, in large enough doses, can cause death.

Hazards of Skin or Eye Contact: Overexposure to the eyes can cause severe burns, conjunctivitis and potential permanent damage. Contact with skin can cause severe burns. If contact is with broken skin there may be formation of firmly marginated “chrome sores”. May, in rare situations, cause allergic contact dermatitis. Dermal absorption of large amounts may lead to kidney failure and death.

Hazards of Inhalation: Inhalation of vapor, mist or liquid may cause burns of the respiratory tract and perforation of the nasal septum. Long term exposure can lead to respiratory cancer.

Hazards of Ingestion: Ingestion can cause severe tissue destruction. May cause liver damage, kidney failure and result in death.

FIRE HAZA5RDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Under fire conditions, decomposing material may form a hot viscous foam.

Hazardous Decomposition Products: At 250°C (482°F) gives off oxygen, and chromic oxide.

EXPLOSION HAZARDS

Explosive Potential: Chromic acid is noncombustible but will accelerate the burning of combustible materials. Under extreme heat it will decompose to chromic oxide and oxygen. Oxygen can then create a high combustion hazard or accelerate combustion.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

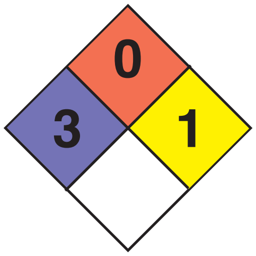
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn. Compatible materials include polyvinyl chloride, nitrile rubber, polyethylene, chlorinated polyethylene and Viton®. Suitable materials for construction are Tyvek® QC and Tychem® SL (longer than 8 hours).

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operation and where airborne concentrations are within the acceptable levels for their use. Protection by air purifying respirators is limited.

1755

CHROMIC ACID SOLUTION

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Contact with eyes can cause severe burns and permanent eye damage. Skin contact can cause severe burns and in cases of large dermal absorption may lead to kidney failure and even death. Inhalation can cause burns to the respiratory tract, perforation of the nasal septum, and may lead to respiratory cancer. Ingestion can cause severe tissue damage, kidney failure, liver damage or death.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. If the patient is conscious, irrigate the nasal passages and mouth with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, flush with large amounts of water. Remove contaminated clothing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large amounts of water or milk if patient is conscious. Do not induce vomiting without seeking medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physicians: Ascorbic acid administered intravenously and locally is reported to be an effective antidote (converting C6 to C3) in preventing renal tubular failure.

FIRE RESPONSE

Extinguishing Agents: Since material will not burn, select appropriate agent for surrounding fire. Chromic acid solution can generate oxygen to accelerate combustion. Water or foam is not recommended since water can cause a steam explosion, especially in a confined area and adding water will not significantly change the pH.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Stop flow if it can be accomplished safely. Use water to protect exposures or prevent containers from failing. Do not flood spill material with water since it does not significantly reduce the pH. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain toxic gases.

SPILL RESPONSES

General Information: Chromic acid is a highly toxic and corrosive liquid that may cause environmental contamination. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Underflow dams are not an effective means to dike material since it mixes with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic and/or corrosive. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Personal protective equipment contaminated with strong chronic acid can self-ignite after it dries, especially if previously contaminated with oil or grease. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the immediate area in all directions if a bulk container of the liquid is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind if there is a large spill or the material is involved in a fire.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if concentrations exist and when conditions are safe to reenter the area. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted.

TECHNIQUE

MONITOR THE SITUATION . . . Chromic acid solution is not expected to evolve large amounts of hazardous airborne contaminants. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

CHROMIC ACID SOLUTION

Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

CHROMIC ACID SOLUTION
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralization agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

August 1997

CHROMIUM TRIOXIDE, ANHYDROUS

Division 5.1 (Oxidizing Material)

GENERAL INFORMATION

Chromium trioxide is an odorless, dark purplish red crystalline material or powder used for chrome plating, the manufacture of inks, paints and other chemicals, process engraving, anodizing and a variety of other purposes. It is produced by treatment of dichromate (e.g. $Na_2Cr_2O_7$) with sulfuric acid. It is soluble in water and becomes corrosive, acidic and evolves heat. It is also soluble in alcohol, ethanol, ether, ethyl ether and sulfuric and nitric acids. The solid weighs approximately 168.5 lbs/ft^3 and will readily absorb moisture from the air.

NIOSH considers chromium trioxide a potential occupational carcinogen. It is considered hazardous through all routes of entry. Although it is not flammable it contributes to the combustibility of other materials and it can ignite combustible materials due to its powerful oxidizing potential. It can cause severe burns upon contact, kidney failure and, in large enough doses, cause death. It is stable, although it is incompatible with numerous materials. Explosions can occur in contact with reducing agents, acetic acid or anhydrides, acetone, methyl alcohol, phosphorous, potassium, ferricyanide, pyridine and sulfur. Toxic chromium fumes may be emitted if exposed to fire and the decomposing material may form a hot viscous foam. Caution should be used to prevent a steam explosion where water is used to fight fires.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very soluble, 62-63%.

Solubility in Other Chemicals: Soluble in alcohol, ether, ethanol, ethyl ether, sulfuric and nitric acids.

Specific Gravity: 2.70 at 20°C (68°F)

Boiling Point: 250°C (482°F), decomposes.

Melting Point: 197°C (387°F)

Freezing Point: Unavailable

Molecular Weight: 100.00

Vapor Pressure: Negligible

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Flammable Limits: Not flammable

Stability: Stable.

Polymerization Potential: Will not occur.

pH: 1.1 in a 1% solution at 25°C (72°F)

Corrosiveness: Corrosive to steel, iron, copper, bronze, brass, nickel, aluminum, and silver. Also attacks cloth, leather and some plastics, possibly causing spontaneous ignition.

Reactivity and Incompatibility: Reacts with heat, acids, phosphorus, arsenic, ammonia, hydrogen sulfide, potassium, sodium selenium, dimethylformamide, alkalis, metals. Avoid contact with oils and greases or any organic or easily oxidizable material. Dangerous ignition hazards occur when contacted with methanol, ethanol, butanol, isobutanol, acetaldehyde, propionaldehyde, butyraldehyde, benzaldehyde, acetic acid, pelargonic acid, ethyl acetate, isopropyl acetate, pentyl acetate, diethyl ether, methyldioxane, dimethyldioxane, acetone, benzylethylaniline and other substances. May attack some forms of plastics, rubbers and coatings.

Reactivity with Water: Produces heat during formation of H_2CrO_4.

Other Characteristics: Strong oxidizing agent. This product will absorb moisture from the air and form a wet solid or solution.

IDENTIFICATION

Shipping Name(s): Chromium trioxide, anhydrous (USDOT & IMO); Chromic acid, solid (USDOT)

Synonyms and Tradenames: Chromic acid; Chromic (VI) acid; Chromic anhydride; Chromium oxide; Chromium (VI) oxide; Chromium trioxide; Chromium (6+) trioxide; Chromium trioxide, anhydrous; Monochromium oxide; Monochromium trioxide.

CAS Registry No: 1333-82-0

Chemical Formula: CrO_3

Constituent Components (% each): 99 - 100% Chromium trioxide

UN/NA Designation: UN1463 (USDOT & IMO) Chromium trioxide, anhydrous; NA1463 (USDOT) Chromic acid, solid

IMO Designation: 5.1

RTECS Number: GB6650000

NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 1 (Reactivity)

Physical Form as Shipped: Solid

Physical Form as Released: Solid

Color of the Shipped Material: Dark red, bipyramidal prismatic crystals, flakes or granular powder.

Odor Characteristics: Odorless

Reportable Quantity: See appendix I

Common Uses: Wood treating, copper stripping, aluminum anodizing, as a catalyst, refractories, in organic synthesis, photography, metal finishing, plating, leather industries, pigments, and used in many reactions for production or purification of chemicals

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CHROMIUM TRIOXIDE, ANHYDROUS

Division 5.1 (Oxidizing Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: NIOSH lists chromic acid as a potential occupational carcinogen. It is corrosive to the eyes, skin and respiratory tract. May cause liver damage or be fatal if swallowed, inhaled or absorbed through the skin. Noncombustible solid but will accelerate the burning of combustible materials. Powerful oxidizer. Under fire conditions, decomposing material may form a hot viscous foam.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): .001 mgCr(IV)/m^3

Ceiling (C) Limit: .1 mg/m^3

IDLH: 15 mg/m^3 as Cr(IV)

Conditions to Avoid: Contact with incompatible materials, organic materials, heat acids, alkalis, metals, oils, greases or any other easily combustible materials. Inhalation of dust or ingestion.

HEALTH HAZARDS

Potential Health Hazards: Routes of exposure are through ingestion, inhalation and eye and skin contact NIOSH lists chromic acid as a potential occupational carcinogen. It causes severe burns upon contact, kidney failure and, in large enough doses, can cause death.

Hazards of Skin or Eye Contact: Overexposure to the eyes can cause severe burns, conjunctivitis and potential permanent damage. Contact with skin can cause severe burns. If contact is with broken skin there may be formation of firmly marginated “chrome sores”. May, in rare situations, cause allergic contact dermatitis. Dermal absorption of large amounts may lead to kidney failure and death.

Hazards of Inhalation: Inhalation of vapor, mist or dust may cause burns of the respiratory tract and perforation of the nasal septum. Long term exposure can lead to respiratory cancer.

Hazards of Ingestion: Ingestion can cause severe tissue destruction. May cause liver damage, kidney failure and result in death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Decomposing material forms hot viscous foam that may cause steam explosion upon contact with water.

Hazardous Decomposition Products: At 250°C (482°F) gives off oxygen, and chromic oxide.

Hazardous Combustion Products: Decomposes with toxic fumes.

EXPLOSION HAZARDS

Explosive Potential: Chromic acid is noncombustible but will accelerate the burning of combustible materials. Under extreme heat it will decompose to chromic oxide and oxygen. Oxygen can then be a combustion hazard. Contact of water with molten solid may result in steam explosion.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

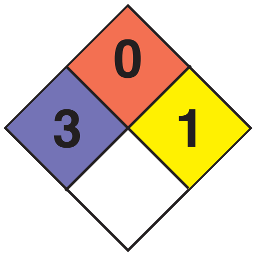
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn. Compatible materials include polyvinyl chloride, nitrile rubber, polyethylene, chlorinated polyethylene and Viton®. Suitable materials for construction are Tyvek® QC and Tychem® SL (longer than 8 hours).

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) with full facepiece is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operation and where airborne concentrations are within the acceptable levels for their use. Protection by air purifying resperator is limited.

1463

CHROMIUM TRIOXIDE, ANHYDROUS

Division 5.1 (Oxidizing Material)



FIRST AID

Nonspecific Symptoms: Contact with eyes can cause severe burns and permanent eye damage. Skin contact can cause severe burns and in cases of large dermal absorption may lead to kidney failure and even death. Inhalation can cause burns to the respiratory tract, perforation of the nasal septum, and may lead to respiratory cancer. Ingestion can cause severe tissue damage, kidney failure, liver damage or death.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. If the patient is conscious, irrigate the nasal passages and mouth with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, flush with large amounts of water. Remove contaminated clothing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large amounts of water or milk if patient is conscious. Do not induce vomiting without seeking medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physicians: Ascorbic acid administered intravenously and locally is reported to be an effective antidote (converting C6 to C3) in preventing renal tubular failure.

FIRE RESPONSE

Extinguishing Agents: Since material will not burn, select appropriate agent for surrounding fire. Chromic trioxide can generate oxygen to accelerate combustion.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water to protect exposures or prevent containers from failing. Do not flood spill material with water since it does not significantly reduce the pH. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Dike fire control water for proper disposal since it may contain toxic material. Note that under fire conditions, decomposing material may form a viscous foam.

SPILL RESPONSES

General Information: Chromic acid is a highly toxic and corrosive liquid that may cause environmental contamination. Confine and contain runoff. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Underflow dams are not an effective means to dike material since it mixes with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic and/or corrosive. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Personal protective equipment contaminated with strong chronic acid can self-ignite after it dries, especially if previously contaminated with oil or grease. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Usually chromium trioxide will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spill is removed.

CONSEQUENCE

Hazardous levels of chromium trioxide in air may be found in the local spill area and immediately downwind under appropriate conditions.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind to unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover all solid chromium trioxide with a plastic sheet or other compatible materials to prevent airborne dust or contact with water.

CONSEQUENCE

Cover material will be contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to chromium trioxide, dust or mist, in air may reduce airborne concentrations.

CONSEQUENCE

Runoff may contain toxic and corrosive concentrations of material.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where material is likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Protect solid from becoming wet. Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. Runoff may be toxic and corrosive. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

CHROMIUM TRIOXIDE, ANHYDROUS

Division 5.1 (Oxidizing Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

CHROMIUM TRIOXIDE, ANHYDROUS

Division 5.1 (Oxidizing Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralization agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

July, 1994

COAL TAR DISTILLATES*
Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Coal tar distillates refers to a range of hydrocarbon mixtures, derived from the distillation of coal tars, which have a flash point from below 23°C (73°F) and a boiling point above 35°C (95°F). The composition of these mixtures is variable but they will contain a range of aromatic hydrocarbons which include benzene, toluene, xylene, anthracene, acridine, acenapthene, chrysene, naphthalene, biphenyl, and others. Benzene, toluene and xylene (BTX) are obtained at the lower end of the distillation range and anthracene, acridine, and naphthalenes are obtained at the higher end of the range. Generally, products obtained at the lower end (light ends) of the range have a lower flash points, are less dense than water, and lighter in color. In contrast, products obtained at the higher end of the range (heavier ends) are darker brown, have higher flash points, and are heavier than water. Light end distillates have higher vapor pressures and lower boiling points than heavier ends and tend to be dominated by BTX mixtures. Shipments of coal tar distillates will be classified as either flammable or combustible and may be assigned to packing groups II or III. If shipped as combustible, the flash point will be between 38°C (100°F) and 93.3°C (200°F). Flammable liquid shipments assigned to packing group lI will have a flash point less than 23°C (73°F) and a boiling point of greater than 35°C (95°F). Flammable liquid shipments assigned packing group III will have flash points of from 23°C (73°F) to 60.5°c (141°F), and boiling points of greater than 35°C (95°F).

As a complex and variable mixture, the properties of coal tar distillates are variable and can only be expressed in general terms. The solubility of individual constituents is variable but, generally, coal tar distillates are only slightly soluble in water. The specific gravity ranges from slightly greater than that of water to slightly less than water and, as a result, spills in water carry contaminants which may float or sink, with trace contaminants mixing in the water column. Light ends will tend to float and heavier ends will tend to sink but will leave a sheen on the water's surface.

Coal tar distillates are considered toxic by all exposure routes. Skin contact may produce burns. Inhalation of vapors is likely in the immediate vicinity of the spill. Coal tar distillates will likely contain components which are suspected human carcinogens, such as benzene. Coal tar distillates are used for a variety of purposes including solvents, fuels, and feedstocks.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, varying with individual components.
Solubility in Other Chemicals: Soluble in benzene.
Specific Gravity (Liquid): 0.8 - 1.05
Vapor Density (Air=1): Unavailable.
Boiling Point: Variable, above 35°C (95°F).
Melting Point: Unavailable.
Freezing Point: .Unavailable.
Molecular Weight: Mixture.
Heat of Combustion: Greater than - 8880 cal/gm.
Vapor Pressure: Unavailable.
Flash Point: Depends on the mixture 23°C (73°F) or lower to 93.3°C (200°F).
Autoignition Temperature: Unavailable.
Burning Rate: Unavailable.
Stability: Stable, not subject to violent polymerization.
Corrosiveness: Irritant to tissues.
Reactivity with Water: Not reactive with water.
Reactivity with Other Chemicals: Will react with oxidizers, as do most organic materials. May be destructive to some plastics.

IDENTIFICATION

Shipping Names: Coal Tar Distillates.
Synonyms and Tradenames: Coke oven light oil, CAS 65996-78-3, (BTX, coal tar light oil, light oil); solvent naphtha, CAS 65996-79-4 (coal tar naphtha solvent, unwashed solvent naphtha); coal tar oil, CAS 65996-82-9 (intermediate light oil, naphthalene oil).
Chemical Formula: Mixture.
Constituent Components (% each): Variable, benzene, toluene, xylene, and higher molecular weight compounds.
UN/NA Designation: UN1136
IMO Designation: 3.2 or 3.3, flammable liquid.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Light, straw colored to dark brown.
Odor Characteristics: Aromatic, irritating, sulfurous.
Common Uses: Solvent for roofing compounds, additive for tar preparations, solvent for creosote. Solvents in printing operations and chemical feedstocks.

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*Reportable Quantity (RQ) established. Refer to appendix I.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

COAL TAR DISTILLATES

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Xylene, 0.2 - 4 ppm (0.87 - 17.4 mg/m^3)

Unusual Hazards: Coal tar distillates are flammable. Light ends will be more easily ignited than heavier ends depending on the mixture. Vapor densities are heavier than air and, depending on the volatility of the material involved, may flashback from an ignition source.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): Unavailable.

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Hazards primarily from direct contact. Mixtures may contain suspected carcinogens such as benzene. Toxic by all exposure routes including skin absorption. Direct exposures may produce burns to exposed tissues. May de-fat exposed skin. Inhalation exposures may produce central nervous system effects.

Hazards of Skin and Eye Contact: Direct contact with eye tissue will produce varying degrees of irritation including burns. Vapors may produce eye irritation. Skin contact with liquids may produce varying degrees of irritation, including severe burns, depending on the amount and duration of exposure. Components may be absorbed through the skin (eg. benzene, toluene, xylene), de-fatting exposed areas and producing symptoms of dizziness and loss of coordination. In severe exposures, may produce cardiovascular collapse or death.

Hazards of Inhalation: Respiratory irritant. May produce systemic symptoms targeting the central nervous system. Symptoms may include dizziness, loss of coordination, excitation and, in severe exposures, cardiovascular collapse and death.

Hazards of Ingestion: Will likely produce irritation to exposed tissues. Irritation may be severe and bleeding may occur. May produce systemic effects acting on the central nervous system including dizziness, loss of coordination and circulatory collapse. Severe exposures may result in fatality.

FIRE HAZARDS

Lower Flammable Limit: Unavailable. Highly variable.

Upper Flammable Limit: Unavailable. Highly variable.

Behavior in Fire: Light ends are more volatile and may produce vapors which could concentrate in low lying areas or confined spaces. This may represent a potential for explosive ignition. Vapor generation from heavier ends will be lower and vapor concentrations are likely to be of greatest concern in the immediate spill vicinity. Shipments assigned to packing group II will likely present a greater risk of fire since they will have the lower flash points of the coal tar distillates. Packing group III shipments will have higher flash points and will likely present less of an ignition hazard than packing group II material. Coal tar distillates classified as combustible will present the lowest level of fire risk with flash points between 38°C (100°F) and 93.3°C (200°F)

Hazardous Combustion Products: May include a variety of unburned aromatic hydrocarbons, carbon monoxide, carbon dioxide and others. Smoke is irritating and may include toxic constituents.

EXPLOSION HAZARDS

Explosiveness: Light ends may produce vapors which could ignite explosively in confined settings. Containers of light end products may rupture violently if exposed to intense heat in fire situations. Heavier end products are less likely to exhibit this behavior.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully covering or encapsulating suits, made of compatible material are appropriate for most large spill situations. Viton and neoprene have been suggested as suitable materials of construction. Neoprene is attacked but breakthrough times are reported as greater than one hour.

1136

COAL TAR DISTILLATES

Class 3 (Flammable Liquid) or Combustible Liquid

PROTECTIVE CLOTHING AND EQUIPMENT (CONTINUED)

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

FIRST AID

Nonspecific Symptoms: Direct exposures may produce localized irritation to tissue or burns if exposures are severe. Inhalation and ingestion may produce irritation and burns to mucous membranes. Central nervous system effects may develop with severe exposures by inhalation or ingestion.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to progressive signs of respiratory distress. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance.

First Aid for Ingestion: Do not induce vomiting. Provide supportive care and seek medical assistance immediately. The risk of systemic toxicity is high when contaminant is aspirated into lungs. The decision to empty the stomach contents should be made by a physician considering the relative risks from toxicity and the danger from aspiration.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, compatible multi-purpose foam, carbon dioxide, water fog, or dry chemical extinguishing agents. Water as a direct stream may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with coal tar distillates. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water as a direct stream may be ineffective. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam is appropriate for fires involving coal tar distillates.

SPILL RESPONSES

General Information: Coal tar distillates are flammable. The severity of fire threat will depend on the nature of the product involved. Light ends are more volatile and have a lower flash point than the heavier ends. When mixed with water, the lighter ends (BTX) will float on the water surface. Heavier ends will also contain BTX as well as other light ends in the mixture, however, the specific gravity is generally greater than 1 and mixtures will tend to sink in the water column. A sheen will develop on the water's surface when heavier ends are spilled. Trace contaminants may be distributed in the water column. Light ends are likely to distribute more quickly in a spill situation as they are of lower viscosity. Response strategies should account for the fact that flammable vapors, particularly with light ends, are heavier than air and may travel some distance to a source of ignition. Intact containers containing coal tar distillates may rupture violently if exposed to extreme heat or fire. All spill responses should consider that until the product is removed to safe containers, ignition is possible. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of coal tar distillates may result in explosion.

COAL TAR DISTILLATES
Class 3 (Flammable Liquid) or Combustible Liquid

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Lighter ends of coal tar distillates may produce sufficient vapors to expose locally downwind areas to toxic or flammable concentrations over some distances. Increases in spill surface area and temperature will increase vapor release.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Coal tar distillates, particularly heavier ends, may not evolve large amounts of hazardous airborne contaminants. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of coal tar distillate vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

MITIGATION

Remove spilled material as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for flammable vapor concentrations.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog applied to coal tar distillate vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks and may not be necessary where heavier distillate ends are involved.

CONSEQUENCE

Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of coal tar distillate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with coal tar distillates.

COAL TAR DISTILLATES
Class 3 (Flammable Liquid) or Combustible Liquid

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of coal tar distillates on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Material may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking coal tar distillates.

CONSEQUENCE

Distillate mixtures may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Coal tar distillates are flammable and explosion proof (intrinsically safe) equipment must be used.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

MECHANICAL REMOVAL . . . Soils contaminated with coal tar distillates may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines. Explosion proof (intrinsically safe) equipment must be used due to the flammability of the material.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Removed materials may pose a continued risk of fire or contamination.

MITIGATION

Decontaminate all equipment after use, with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

COAL TAR DISTILLATES
Class 3 (Flammable Liquid) or Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

CONTAINMENT . . . Heavier coal tar fractions are denser than water and will tend to sink to the bottom, depending on the velocity of the water body. Use natural deep water pockets, excavated lagoons, or barriers to trap material on the bottom and limit spread of contamination.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Excavations are difficult and are not 100% effective.

MITIGATION

Monitor downstream users and test for signs of contamination. Excavate as a last resort. Take steps to remove trapped pockets of product as soon as possible.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible materials may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of the lighter coal tar distillate fractions.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating product components.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose a hazard to future users. Fire hazards pose risk to personnel and equipment.

MITIGATION

Decontaminate equipment after use. Store recovered material in a safe and secure location. Use compatible equipment. Eliminate ignition sources.

CRESOL

Divison 6.1 (Poisonous Material)

GENERAL INFORMATION

Cresol, also known as cresylic acid, is typically a mixture of three isomers (o-, m-, and p-cresol) that may be colorless, yellowish, brownish-yellow, or pinkish. The mixture has a sweet tarry odor and is used as a disinfectant, as an ore flotation agent, and for making chemicals, dyes, plastics,antioxidants, explosives, and photographic developing agents. It is somewhatsoluble in water and very slightly heavier, so may be expected to sink(eventually) and dissolve at a slow to moderate rate. Flash points are typically in the range of 175-202°F and indicate that the product must be heated before ignition may occur easily. The product weighs approximately 8.6-8.7 pounds per gallon. The properties and hazards of the individual isomers are very similar, so this guide pertains to these isomers singly as well as in combination.

Cresol does not react with water or many other common materials and is stable in normal transportation. It is a highly toxic substance and is very corrosive to bodily tissues. Products of combustion are also considered highly toxic.

If the material is on fire or involved in fire, toxic combution products may be formed; downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. If the material is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equiped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Somewhat soluble, 1.9-2.5 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, carbon tetrachloride, ether, glycol, and dilute alkalis.

Specific Gravity (Liquid): 1.03-1.07 at 68°F (20°C)

Boiling Point: 375.7-396°F (191-202.2°C) at 1 atm.

Melting Point: 52.7-94.6°F (11.5-34.8°C)

Freezing Point: 52.7-94.6°F (11.5-34.8°C)

Molecular Weight: 108.15

Heat of Combustion: –8180 to –8190 cal/g

Vapor Pressure: 0.1080-0.2453 mm Hg (0.002-0.005 psia) at 77°F (25°C)

Flash Point: 175-202°F (79.4-94.4°C)

Autoignition Temperature: 1038-1110°F (559-599°C)

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Not considered corrosive to usual materials of construction.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with strong oxidizers.

IDENTIFICATION

Shipping Names: Cresol (USDOT), cresols (IMO), cresylic acid (IMO).

Synonyms and Tradenames: Methyl phenol; cresylic acid; oxytoluene; hydroxytoluene; m-cresol; o-cresol; p-cresol; 1-hydroxy-3-methylbenzene;1-hydroxy-2-methylbenzene; 1-hydroxy-6-methylbenzene; cresole; kresol; tekresol; tricresol.

Chemical Formula: $CH_3CH_6H_4OH$

Constituent Components (% each): Various grades of mixtures and pure isomers. Impurities may include phenol and/or xylenols and may alter some properties.

UN/NA Designation: UN2076 (cresols); UN2022 (cresylic acid)

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid (may solidify)

Color of the Shipped Material: Colorless, yellowish, brownish yellow, or pinkish.

Odor Characteristics: Sweet, tarry

Common Uses: Disinfectant; ore flotation agent; mfg. chemicals, dyes, plastics, antioxidants, explosives, and photographic developing agents.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CRESOL
Divison 6.1 (Poisonous Material)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.68 ppb-68 ppm; reported values vary

Unusual Hazards: Highly toxic; corrosive to bodily tissues; rapidly absorbed through the skin.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): (Skin) 5 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to high vapor concentrations in air that may occur in the local spill area and immediately downwind. Ingestion and direct contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with liquid cresols may cause wrinkling, white discoloration, softening, and possibly gangrene of the skin; a burning and prickling sensation starts after a few minutes of contact and is followed by numbness. Absorption through the skin may occur and death may result from extensive exposures. Skin rashes may result from lesser exposures.Contact with the eyes may cause extensive damage and possible loss of vision.

Hazards of Inhalation: Vapors of cresol are irritating to the eyes, nose, and throat. High concentrations in air may cause headache, dizziness, dimness of vision, ringing of the ears, rapid breathing, weak pulse, profound weakness, mental confusion, and sometimes death. Effects may develop within 20-30 minutes in acute exposures. Chronic exposures may result in damage to the liver and kidneys, vomiting, diarrhea, loss of appetite, difficulty in swallowing, headache, salivation, fainting, dizziness, mental disturbance, pulmonary edema, and possibly death.

Hazards of Ingestion: Systemic effects of ingestion are similar to the effects of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 1.06-1.35% at approx. 300°F (150°C)

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite. There is some very limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: Considered highly toxic.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of hot liquid are ignited in a confined area. There is some very limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots,gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high smoke or fume concentrations in air. Compatible materials may include natural rubber, neoprene, chlorinated polyethylene, and Saranex.

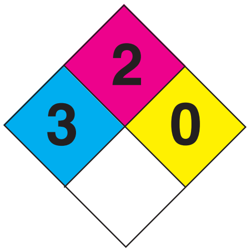
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 ppm), a self-contained breathing apparatus (SCBA) with full face piece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (250 ppm or less) or an organic vapor cartridge respirator with a full face piece (250 ppm or less) within the use limitations of these devices. These latter devices should also be fitted with a dust and mist filter.

2076

CRESOL

Divison 6.1 (Poisonous Material)

See UN/NA Designation for
other ID numbers.



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources where necessary. Protect sewers and waterways from contaminated runoff. Notify proper authorities, down stream sewer and water treatment operations, and other down stream users of potentially contaminated water. Note that intake of cresol may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that cresol is highly toxic by all routes of exposure including absorption through the skin. It is not very volatile, however, and may fully or partially solidify when spilled.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Cresol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of cresol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to cresol vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water run off may contain a small amount (if any) of cresol from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose run off or rain water that may add to spill volume and overfill impoundments.

CRESOL
Divison 6.1 (Poisonous Material)

TECHNIQUE

FOAM ... There is a possibility that firefighting foam applied to the surface of pools may slow the release of cresol vapors into the atmosphere.(Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Cresol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained cresol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread ofcontamination. Be alert to conditions such as fire hose runoff or rain water that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for ground water contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where ground water contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Cool temperatures may cause cresol to solidify and plug equipment.

MITIGATION

Use compatible equipment. Monitor or control temperature of product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

CRESOL
Divison 6.1 (Poisonous Material)

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT ... Spilled product will eventually sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING ... Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

CRESOL
Divison 6.1 (Poisonous Material)

TECHNIQUE

ADSORPTION ... Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 2000

CROTONALDEHYDE, STABILIZED

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Crotonaldehyde is a flammable, highly toxic, colorless to pale yellow or straw colored liquid with a pungent, suffocating, tar-like odor that quickly brings tears to the eyes. It is used for a variety of purposes, is quite soluble in water, and will dissolve rapidly. The lowest reported flash point for the pure material of 45ºF indicates the product is easily ignited under a wide range of ambient temperature conditions. Vapors which evolve from warm crotonaldehyde may be heavier than air and may travel some distance to a source of ignition and flash back at any temperature above the flash point. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is a possibility that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 7.1 pounds per gallon.

Crotonaldehyde handled in commerce typically contains some amount of water that stabilizes and inhibits the product from violent self-polymerization upon exposure to excessive heat or fire conditions, which may result in violent rupture of closed containers. Authorities appear to disagree, however, on the degree of protection afforded by mixture with water. Many claim that self-polymerization remains a possibility upon excessive heating while others specify that polymerization will not occur. Due to the uncertainty involved, this guide generally assumes that violent polymerization is indeed possible upon sufficient exposure to heat and may result in violent rupture of closed containers.

Crotonaldehyde does not react with water or many other common materials. It is generally stable in normal transportation but readily resinifies to a dimer when pure and slowly oxidizes to crotonic acid. May also react with oxygen in air to form potentially explosive peroxides after a time. Besides excessive heat, violent polymerization may also be initiated by contact with various alkaline materials or acids and the product is also incompatible with strong oxidizing and reducing agents. Toxicity hazards of the product are considerable by all routes of exposure and primarily derive from the highly irritating nature of the substance. Products of combustion may include toxic and irritating constituents.

If crotonaldehyde is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: 5.5 or 18.1g/100g water at 68ºF (20ºC); reported values vary.

Solubility in Other Chemicals: Soluble with alcohol, ether, benzene, acetone, toluene, kerosene, gasoline, or solvent naphtha.

Specific Gravity (Liquid): 0.85 at 68ºF (20ºC)

Vapor Density: 2.41

Boiling Point: 210 - 221ºF (99 - 105ºC) at 1 atm.

Melting Point: -105.7 to -101.2ºF (-76.5 to -74ºC)

Freezing Point: See melting point

Molecular Weight: 70.09

Heat of Combustion: -7760 cal/g

Evaporation Rate (butyl acetate=1): 2.7

Vapor Pressure: 30 - 32 mmHg (0.58-0.62 psia) at 68ºF (20ºC)

Flash Point: Approximately 55ºF (12.8ºC) closed cup and 127.4ºF (53ºC) open cup for 93% solution; about 45ºF (7.2ºC) closed cup and 55ºF (12.8ºC) open cup for anhydrous product; reported values not well defined.

Autoignition Temperature: 320ºF (161ºC), 405ºF (207ºC), or 450ºF (405ºC); reported values vary.

Burning Rate: 3.3 mm/minute

Flammable Limits: 2.1% (LEL) - 15.5% (UEL)

Stability: Generally stable in normal transportation but readily resinifies to a dimer when pure and slowly oxidizes to crotonic acid.

Polymerization Potential: Violent polymerization occurs in contact with alkaline materials like caustics, ammonia, or amines or with acids. May polymerize at elevated temperatures as in fire conditions.

Corrosiveness: Relatively noncorrosive. Compatible with aluminum or stainless steel. May attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Readily converted by oxygen (even in air) to hazardous and potentially explosive peroxides and to acids. Also incompatible with strong oxidizing and reducing agents and butadiene.

IDENTIFICATION

Shipping Name(s): Crotonaldehyde, stabilized (USDOT & IMO)

Synonyms and Tradenames: 2-Butenal; Crotonic aldehyde; Crotonal; beta-Methyl acrolein; Propylene aldehyde; 1,2-Ethanediol, dipropanoate; Ethylene glycol, dipropionate; Ethylene dipropionate; Ethylene propionate.

CAS Registry No.: 4170-30-3

Chemical Formula: $CH_3CHCHCHO$

Constituent Components (% each): Commercial crotonaldehyde is the trans isomer of this substance; usually 93% pure with remainder as water acting as stabilizer, but other concentrations may also be shipped.

UN/NA Designation: UN1143

IMO Designation: 6.1, Toxic substances

RTECS Number: GP9499000

NFPA 704 Hazard Rating: 4(Health): 3(Flammability): 2(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless; turns to pale yellow in light and air.

Odor Characteristics: Pungent; suffocating; penetrating; like tar.

Reportable Quantity: See appendix I.

Common Uses: Solvent; insecticides; tear gas; leather tanning; denaturant; purification of lube oils; mfg. rubber accelerators and other chemicals; warning agent in fuel gases.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CROTONALDEHYDE, STABILIZED

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.035-0.2 ppm; reported values vary.

Unusual Hazards: Relatively volatile flammable liquid with vapors that are highly toxic at low concentrations in air. There is potential for the product to violently self-polymerize when heated or in the presence of alkaline materials or acids.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 2 ppm (6 mg/m^3)

Ceiling (C) Limit: 0.3 ppm (ACGIH)

IDLH: 50 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact. Avoid allowing the product to evaporate to near dryness.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid crotonaldehyde may cause severe irritation or burns and possibly result in absorption of toxic amounts of this product through the skin if the exposure is excessive. Even high concentrations of vapors in air can cause a burning skin irritation. Contact of the liquid with eyes has the potential to cause severe injury and burns. Eye discomfort and irritation with tearing becomes considerable at vapor concentrations of 45 ppm in air in a few seconds.

Hazards of Inhalation: Vapors of crotonaldehyde are irritating to the nose and throat and may cause coughing, difficult breathing, chest pain, nausea, vomiting, pulmonary edema (which may be delayed in onset), and possibly death. Exposure to only 4 ppm in air can cause upper respiratory irritation and tearing of the eyes in 10 minutes. Rats did not survive exposure to 1650 ppm in air for 10 minutes in laboratory experiments and exhibited respiratory distress, an excitatory stage, and terminal convulsions.

Hazards of Ingestion: Ingestion of crotonaldehyde may cause gastrointestinal distress and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 2.1-2.15% or 2.9-2.95%; reported values vary.

Upper Flammable Limit: 15.5% or 19.5%; reported values vary.

Behavior in Fire: Exposure of containers to fire or heat may result in violent polymerization and possible container rupture. Will generate large quantities of flammable gas or vapor upon release. Vapors may be heavier than air at warmer temperatures and may travel some distance to a source of ignition and flash back.

Hazardous Combustion Products: Not well defined but considered highly irritating and toxic and may contain carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Excessive heat may cause spontaneous polymerization resulting in violent container rupture. Violent polymerization may also occur in presence of certain alkaline materials and acids.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

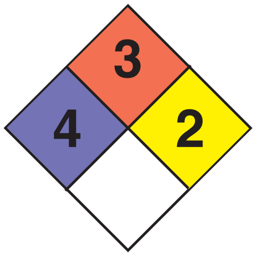
Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas tight safety goggles, and other impervious and resistant clothing. Butyl rubber is reported to provide more than 8 hours of protection, while Teflon® is reported to provide more than 4 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases according to some authorities to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece (100 ppm or less) within the use limitations of these devices.

1143

CROTONALDEHYDE, STABILIZED

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues, excessive tears in the eyes, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Authorities disagree on whether or not vomiting should be induced, probably due to the possibility that aspiration into the lungs during vomiting may lead to pulmonary edema or other injury. Seek immediate medical advice on this issue where possible.)

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, alcohol resistant foam (or possibly regular foam). Water may be ineffective for extinguishment but may be effective for cooling.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Take the relative volatility, flammability, and toxicity of crotonaldehyde into account when planning the response. (Note: In some rare spills, there may be time to apply oil spill containment and cleanup techniques to crotonaldehye floating on water before the chemical dissolves. This guide presumes that dissolution in water will be rapid.) Note that there is potential for the product to polymerize under a variety of conditions. The product should not be allowed to evaporate to near dryness.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

CROTONALDEHYDE, STABILIZED
Division 6.1 (Poisonous Materials)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to crotonaldehyde vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of crotonaldehyde from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL RESISTANT FOAM . . . There is a possibility that alcohol resistant foam applied to the surface of liquid pools may slow the release of crotonaldehyde vapors into the atmosphere. The fact that alcohol resistant foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid crotonaldehyde may slow the release of vapors into the atmosphere. (Note: All of the crotonaldehyde must be dissolved in water.)

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Crotonaldehyde may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined crotonaldehyde may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

CROTONALDEHYDE, STABILIZED

Division 6.1 (Poisonous Materials)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

CROTONALDEHYDE, STABILIZED

Division 6.1 (Poisonous Materials)

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

CYANOGEN
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Cyanogen is shipped as a colorless flammable liquefied compressed gas having an almond-like odor that is acrid and pungent at dangerous levels in air. Once used as a military poison gas, it is now used as a fumigant, in rocket propellants, for welding and cutting metals, and for making other chemicals. Being slightly soluble in water and lighter, and having a low boiling point, it will boil rapidly from the surface of a water body with limited dissolution. Cyanogen gas or vapor is heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.2 pounds per gallon as a liquid when at ambient temperature in a container and close to 8 pounds per gallon at its boiling point.

Cyanogen is stable in normal transportation, does not react with many common materials, and gradually decomposes when dissolved in water. It is reactive with fluorine and oxidizing agents that may cause its ignition, however, may form explosive mixtures with liquid oxygen, and may produce highly toxic fumes in contact with acids. Toxicity of the product must be considered very high by all routes of exposure since it readily causes cyanide poisoning. Products of combustion are also highly toxic and may include nitrogen oxides and cyanides.

If cyanogen is leaking (not on fire), downwind evacuation of the immediate spill area and downwind should be considered. If a fire becomes uncontrollable or a bulk container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently. Note that cylinders may also rupture violently and rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Somewhat soluble; 450 cc gas/100 ml water at 64.4 – 68°F (18 – 20°C).

Solubility in Other Chemicals: Somewhat soluble in alcohol and ether.

Specfic Gravity (Liquid): 0.954 at boiling point; 0.866 at 62.6°F (17°C)

BoilingPoint: – 6.2 to – 4.9°F (– 21.2 to – 20.5°C) at 1 atm.

Melting Point: –18.2°F (– 27.9°C) or – 29.9°F (– 34.4°C); reported values vary.

Freeing Point: See melting point

Molecular Weight: 52.0

Heat of Combustion: – 5033 cal/g

Vapor Pressure: 5.09 atm (74.8 psia) at 70°F (21.1°C)

Flash Point: Flammable gas

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable in normal transportation. High temperatures cause polymerization to insoluble paracyanogens (CN)/*x in apparently nonviolent reaction.

Corrosiveness: Data unavailable, but considered noncorrosive when dry by at least one authority.

Reactivity with Water: Some authorities state the solution gradually decomposes into ammonium oxalate and formate, hydrogen cyanide and urea, while also forming brown amorphous azulmic acid precipitate. Others say cyanogen is slowly hydrolyzed to oxalic acid and ammonia.

Reactivity with Other Chemicals: Reacts with fluorine gas to form white flame. Liquid cyanogen produces explosive mixture with liquid oxygen. Contact with acids or acid fumes may produce highly toxic fumes of nitrogen oxides and cyanides. Incompatible with oxidizing agents.

IDENTIFICATION

Shipping Names: Cyanogen (USDOT and IMO)

Synonyms and Tradenames: Ethanedinitrile; dicyan; oxalonitrile; oxalic acid dinitrile; carbon nitride; dicyanogen; nitriloacetonitrile; oxalyl cyanide; pursside.

Chemical Formula: NCCN

Constituent Components (% each): 98.5% or more pure

UN/NA Designation: UN1026

IMO Designation: 2.3, poison gas

Physical State As Shipped:Liquefied compressed gas

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Like almonds; acrid and pungent at lethal levels in air.

Common Uses: Organic synthesis; former military poison gas; welding and cutting metals; fumigant; rocket propellant.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

CYANOGEN

Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable; odor is not detectable at 250 ppm in air but 16 ppm causes eye and nose irritation in 6 – 8 minutes.

Unusual Hazards: Highly toxic and flammable liquefied compressed gas. Vapors are heavier-than-air and may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact with very cold liquid, gas, or containers.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in the spill area and over considerable distances downwind. All exposures should be strictly avoided.

Hazards of Skin or Eye Contact: Specific data are unavailable but liquid cyanogen is likely to cause frostbite and possibly burns in contact with the skin or eyes. Concentrations of 16 ppm in air are irritating to the eyes and nose in 6 – 8 minutes.

Hazards of Inhalation: Cyanogen interferes with the ability of the blood to carry oxygen via cyanide poisoning. Moderate exposures may result in irritation of the upper respiratory system, headache, dizziness, drowsiness, incoordination, giddiness, confusion, constriction in the chest, rapid breathing, weak rapid pulse, and tremors. High concentrations may rapidly cause convulsions, unconsciousness, and death. A concentration of 350 ppm was lethal to 50% of rats within one hour in laboratory experiments; 2600 ppm was fatal to mice in 12 minutes while 2000 ppm killed cats in 13 minutes.

Hazards of Ingestion: Ingestion of cyanogen is unlikely but the product must be considered highly toxic by this route of exposure. Symptoms are likely to resemble those of poisoning by inhalation.

FIRE HAZARDS

Lower Flammable Limit (LFL): 6.0% or 6.6%; reported values vary.

Upper Flammable Limit (UFL): Most authorities give 32%; a few give 42.6%.

Behavior in Fire: Flammable liquefied compressed gas. Will generate large quantities of flammable and toxic gas upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Burns with pink flame having a bluish or purple tinged border.

Hazardous Combustion Products: Highly toxic, may include nitrogen oxides, cyanides, and unburned cyanogen.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact of liquid cyanogen with liquid oxygen may result in the formation of an explosive mixture.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with liquid cyanogen, cold gas streams, or cold containers of the product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1026

CYANOGEN
Division 2.3 (Poison Gas)

FIRST AID

Nonspecifc Symptoms: Headache, dizziness, drowsiness, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.) If available and necessary, administer amyl nitrile pearl in cloth one inch from mouth and nostrils for 15 seconds. Repeat 5 times at 15-second intervals. Use fresh pearl as necessary every 5 minutes when there is no response until 3 – 4 have been used. Person giving first aid should avoid inhalation of amyl nitrite vapors to avoid possible dizziness.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Stop flow if possible or else allow fire to burn out while cooling surroundings with water spray. Carbon dioxide, dry chemical, or water spray may be used for extinguishment when reignition is no longer possible.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all lines and equipment. Take the highly toxic, flammable, and volatile nature of cyanogen into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Cyanogen spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CYANOGEN
Division 2.3 (Poison Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to cyanogen vapors may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid cyanogen as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of cyanogen from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of cyanogen vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if initial increased vapor evolution may affect downwind populations. Consult qualified experts where necessary.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid cyanogen or contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

CYANOGEN
Division 2.3 (Poison Gas)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines. Note that cyanogen can persist in soil as cyanide.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Although most liquid cyanogen will boil from the surface of the water body (unless the release is below the surface), there is a potential for hazardous amounts to dissolve in water bodies with critical uses.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe. Consult qualified experts for advice.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

CYANOGEN
Division 2.3 (Poison Gas)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

CYANOGEN CHLORIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Cyanogen chloride is a nonflammable liquefied compressed gas that is heavier than air and has a sharp, acrid, choking, pungent odor resembling bitter almonds. It is used for treating metals and their ores, for making synthetic rubber and other chemicals, as a military poison gas, and as a warning agent in fumigant gases. Being slightly soluble and heavier than water, and having a boiling point of 54.5 – 56.8°F, it may be expected to boil or vaporize rapidly from a water body with limited dissolution. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 9.9 pounds per gallon at room temperatures.

Cyanogen chloride is considered stable in normal transportation but at least one authority suggests the possibility of a hazardous polymerization reaction taking place under conditions that are not clearly specified. Other potential reactions are discussed below, but be aware that available data on this topic are extremely limited. Cyanogen chloride is not corrosive to ordinary metals when dry, but becomes corrosive in the presence of moisture. Toxicity of the product is extremely high by all routes of exposure. Involvement in fire may evolve unburned product, toxic oxides of nitrogen, and various toxic chlorides and cyanides.

Downwind evacuation should be considered if cyanogen chloride is leaking until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 2500 cc gas in 100 g water at 68°F (20°C); approximately 30,000 ppm.

Solubility in Other Chemicals: Soluble in alcohol, ether, and other organic solvents to various degrees.

Specific Gravity (Liquid): 1.186 at 68°F (20°C)

Boiling Point: 54.5 – 56.8°F (12.5 –13.8°C) at 1 atm.

Melting Point: 19.6 to 21.2°F (– 6.9 to – 6°C)

Freezing Point: See melting point

Molecular Weight: 61.47

Heat of Combustion: Not flammable

Vapor Pressure: 2.34 atm (34.4 psia) at 70°F (21.1°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable in normal transportation. One authority states that hazardous polymerization may occur if the product is not stabilized or is thermally decomposed. This is not supported by any of the many other references reviewed except (somewhat) by one that states that polymers tend to form upon storage.

Corrosiveness: Not corrosive to ordinary metals when dry. Corrosive in presence of moisture, in which case monel, tantalum, or glass or glass- lined equipment may be used.

Reactivity with Water: Very slow reaction which produces hydrogen cyanide.

Reactivity with Other Chemicals: Tanks containing cyanogen chloride and chlorine and moisture have exploded due to formation of NCl_3. Additional data unavailable. Contact with acids may evolve toxic fumes (possibly containing oxides of nitrogen and cyanides).

IDENTIFICATION

Shipping Names: Cyanogen chloride, stabilized (USDOT and IMO)

Synonyms and Tradenames: Chlorine cyanide; chlorocyanogen; chlorcyan; chlorocyan; chlorocyanide.

Chemical Formula: CNCl

Constituent Components (% each): 97 mole % or more pure; may contain 5% tetrasodium pyrophosphate as stabilizer; may contain small amounts of hydrogen cyanide and hydrogen chloride.

UN/NA Designation: UN1589

IMO Designation: 2.3, poison gas

Physical State As Shipped: Liquefied compressed gas

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Pungent; like bitter almonds; sharp; acrid; choking

Common Uses: Chemical synthesis; military poison gas; warning agent in fumigant gases; metal cleaner; in ore cleaning; making synthetic rubber.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

CYANOGEN CHLORIDE

Division 2.3 (Poison Gas)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at 1 ppm

Unusual Hazards: Highly toxic liquefied compressed gas. Vapors are heavier than air and may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.3 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and over considerable downwind distances. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with liquid cyanogen chloride may result in severe irritation or severe burns of the skin and eyes.

Hazards of Inhalation: Vapors of cyanogen chloride are highly irritating to the eyes, throat, and respiratory tract. Cyanogen chloride exposures interfere with the ability of the blood to carry oxygen via cyanide poisoning. Moderate exposures may result in headache, dizziness, drowsiness, weakness, hoarseness, vomiting, nausea, disorientation, rapid pulse and breathing, hemorrhagic exudate of the bronchi and trachea, and pulmonary edema (which may be delayed in onset). Severe exposures may cause rapid collapse, unconsciousness, convulsions, and death. Exposure to 159 ppm in air for 10 minutes or 48 ppm for 30 minutes may be fatal to humans.

Hazards of Ingestion: Cyanogen chloride is extremely toxic by ingestion. Symptoms and effects of poisoning are similar to those for inhalation. Burns of the mouth, throat, and stomach are also a possibility.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Nonflammable liquefied compressed gas. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of highly toxic gas or vapor upon release.

Hazardous Combustion Products: Involvement in fire may evolve unburned cyanogen chloride, toxic oxides of nitrogen, and various toxic chlorides and cyanides.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Containers may rupture violently in fire due to over-pressurization. Contact with chlorine and moisture in tanks may result in explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with cyanogen chloride. This may include rubber boots, gloves, face shields, splash-proof and gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self- contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include chlorinated polyethylene.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1589

CYANOGEN CHLORIDE
Division 2.3 (Poison Gas)

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; headache, dizziness, drowsiness, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.) If available and necessary, administer amyl nitrite pearl in cloth one inch from mouth and nostrils for 15 seconds. Repeat 5 times at 15-second intervals. Use fresh pearl as necessary every 5 minutes when there is no response until 3 – 4 have been used. Person giving first aid should avoid inhalation of amyl nitrite vapors to avoid possible dizziness.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire. Cyanogen chloride is not itself flammable.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of warm water to standing pools of liquid cyanogen chloride may increase vapor evolution. The boiling point of the product is in the 50 degree Fahrenheit range.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment according to one authority. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile and toxic nature of cyanogen chloride into account when planning the response. Note that vapors and gases are heavier than air and may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Cyanogen chloride spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CYANOGEN CHLORIDE
Division 2.3 (Poison Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to cyanogen chloride vapors or fumes may accelerate their dispersal in the atmosphere. If water is warm, apply it at a point downwind and do not allow it to contact pools of liquid cyanogen chloride as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of cyanogen chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that application of an appropriate firefighting foam to the surface of liquid pools may slow the release of cyanogen chloride vapors into the atmosphere. Use the coldest water available to generate the foam.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Cyanogen chloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained cyanogen chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

CYANOGEN CHLORIDE
Division 2.3 (Poison Gas)

TECHNIQUE

ABSORPTION . . . Some authorities suggest that spreading of liquid cyanogen chloride may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances. Note that the high volatility of cyanogen chloride indicates this response is of limited value in warm and even cool weather.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert. Use alternative technique if volatility of the product precludes effective use of sorbents.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines. (Note: Most residues will evaporate rapidly in many spill situations.)

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Although most liquid cyanogen chloride will rapidly boil or evaporate from the surface of the water body, even low concentrations dissolved in water may be hazardous.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

CYANOGEN CHLORIDE
Division 2.3 (Poison Gas)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniaues where air emissions may pose a downwind hazard.

September 2006

CYCLOHEXANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Cyclohexane is a fairly volatile clear, colorless liquid hydrocarbon with a mild, sweet, solvent odor resembling benzene or chloroform. It is used as a solvent, in paint removers, and for making nylon and other chemicals. Essentially insoluble in water and lighter, the product will form a floating surface slick. Its flash point of 0°F indicates that it can be easily ignited under virtually all ambient temperature conditions. Vapors are somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.5 pounds per gallon.

Cyclohexane does not react with water or many other common materials and is stable in normal transportation. It is incompatible with oxidizing materials, however, and may attack some plastics, rubber and coatings. Toxicity by all routes of exposure is generally low to moderate. Products of combustion may include toxic constituents.

If cyclohexane is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble, less than 0.01 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, methanol, alcohol, benzene, carbon tetrachloride, ether and ligroin.
Specific Gravity (Liquid): 0.779 at 68°F (20°C)
Vapor Density: 2.9
Boiling Point: 177.3°F (80.7°C) at 1 atm.
Melting Point: 43.8°F (6.6°C)
Freezing Point: 43.8°F (6.6°C)
Molecular Weight: 84.16
Heat of Combustion: –10380 cal/g
Evaporation Rate (butyl acetate=1): ~ 6
Vapor Pressure: 78 – 95 mmHg at 68°F (20°C)
Flash Point: 0°F (–18°C), closed cup
Autoignition Temperature: 473 – 518°F (245 – 270°C)
Burning Rate: 6.9 mm/minute
Flammable (Explosive) Limits: 1.3% (LEL) – 8% (UEL)
Stability: Stable
Polymerization Potential: Will not occur
pH: Not applicable
Corrosiveness: Noncorrosive to usual metals but may attack some plastics, rubber and coatings.
Reactivity with Water: No reaction
Reactivity and Incompatibility: May react with strong oxidizers, such as perchlorates, peroxides, permanganates, chlorates, and nitrates. If cyclohexane is heated and mixed with liquid nitrogen dioxide, an explosion occurs.

IDENTIFICATION

Shipping Names: Cyclohexane (USDOT & IMO)
Synonyms and Tradenames: Hexahydrobenzene; Hexamethylene; Hexanaphthene; Benzene hexahydride.
CAS Registry No.: 110-82-7
Chemical Formula: $CH_2(CH_2)_4CH_2$
Constituent Components(% each): 85–99.9% pure, may contain 0.1% or so benzene
UN/NA Designation: UN1145
IMO Designation: 3, flammable liquids
RTECS Number: GU6300000
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Instability)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Mild, sweet, pungent, solvent odor; like benzene or chloroform
Reportable Quantity: See Appendix I
Common Uses: Solvent for cellulose ethers, fats, oils, rubber, lacquer, paint thinners and other substances; mfg. of perfumes, nylon, and organic chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

CYCLOHEXANE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** 25 – 300 ppm

Unusual Hazards: Moderately volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back. Vapors may persist for a time in pits, hollows and depressions. Flowing product may be ignited by self-generated static electricity.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 300 ppm (1050 mg/m^3) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 1300 ppm (10% LEL)

Conditions to Avoid: Heat, fire, and sparks; contact with oxidizing materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air as may be found in the spill area and in downwind locations. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid cyclohexane may cause drying and cracking of the skin due to the defatting action of the product. Splashes of liquid into the eyes may result in irritation.

Hazards of Inhalation: May cause mild irritation of the eyes and upper respiratory tract. High concentrations in air may cause narcosis and central nervous system depression with symptoms including excitement, loss of equilibrium, stupor, dizziness, nausea, vomiting, coma and occasionally death as a result of respiratory failure.

Hazards of Ingestion: May cause mouth and throat irritation, nausea, vomiting, headache, intoxication. Similar to symptoms of central nervous system depression. Aspiration into the lungs during vomiting may result in chemical pneumonitis with possibly severe consequences.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 1.3%

Upper Flammable (Explosive) Limit: 8%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide, irritating aldehydes and ketones and possibly others.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

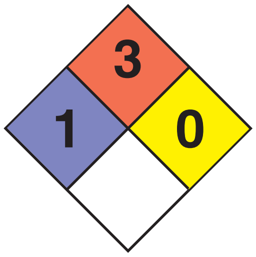
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: nitrile rubber (gloves, suits, boots); Viton®; Tychem® (BR; LV; Responder®; Responder® CSM; TK; F; Reflector®; ThermoPro); Nitri Solve 727® gloves; Viton 890® gloves, Viton 892® gloves, 4H® and Silver Shield® brand gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Teflon®; Polyvinyl alcohol (gloves). The following materials are ***not*** recommended for use: butyl rubbber, natural rubber, neoprene, polyethylene and polyvinyl chloride.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1300 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 1300 ppm): any supplied-air respirator operated in a continuous-flow mode (eye protection needed); any powered air-purifying respirator with organic vapor cartridge(s) (eye protection needed); any air-purifying full-facepiece respirator equipped with organic vapor cartridge(s); any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece.

1145

CYCLOHEXANE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, respiratory tract, or skin; symptoms of central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 15 minutes. Get medical attention immediately if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, foam or water fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Cyclohexane may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable vapors. Note that cyclohexane has a flash point of 0°F.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of cyclohexane may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that cyclohexane is a relatively volatile and flammable liquid that floats on water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

CYCLOHEXANE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Cyclohexane may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly if small amounts have spilled or in cold weather.

CONSEQUENCE

Hazardous levels of cyclohexane in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to cyclohexane vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain cyclohexane from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of cyclohexane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

CYCLOHEXANE

Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . . Cyclohexane may be contained by building dikes or barriers using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained cyclohexane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

CYCLOHEXANE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating cyclohexane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with cyclohexane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

August 1996

CYCLOHEXANONE*

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Cyclohexanone is an irritating, white to pale yellow oily liquid with a peppermint or acetone-like odor. It is used as a solvent for cellulose acetate, nitrocellulose, waxes, fat, vinyl resins, crude rubber, natural resins, shellac, and DDT. Cyclohexanone is also used as a metal degreasing solvent for lacquers, resins, and insecticides, and PVC polymers and copolymers. Over 96% of the cyclohexanone produced is oxidized to adipic acid. Commercial uses include spot remover and degreaser for leather. Cyclohexanone is produced from the catalytic oxidation of cyclohexane. Cyclohexanone is irritating to the eyes, skin and upper respiratory tract. Evidence suggests that skin permeation can occur in amounts capable of producing systemic toxicity. The most common routes of exposure are through inhalation and skin contact. It may be poisonous if inhaled or absorbed through the skin for prolonged periods.

Although the fire potential for cyclohexanone is moderate, heating can release ignitable vapors, which can form explosive mixtures with air. The material is generally stable, however it may form explosive peroxides on exposure to air. When heated to decomposition, the burning material may generate carbon monoxide. Vapors are heavier than air and may settle in low lying areas. Vapors may travel considerable distances to an ignition source and flash back. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for working in atmospheres where Cyclohexanone is present. Runoff from fire control may be flammable and/or toxic. Cyclohexanone is slightly water soluble. This material is incompatible with strong oxidizers and acids such as nitric acid. Empty containers containing product residue may be hazardous and proper safety precautions should be followed.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble (4.8 wt. % @ 30°C [86°F])
Solubility in Other Chemicals: Acetone, ethyl ether, alcohol, ethanol and other common organic solvents.
Specific Gravity (Liquid): 0.95 @ 4°C (39°F)
Vapor Density (Air=1): 3.4
Boiling Point: 156°C (313°F)
Melting Point: -16°C (2°F)
Freezing Point: -31°C (-23°F)
Molecular Weight: 98.14
Heat of Combustion: -15,430 BTU/LB. (-8,570 CAL/G.)
Evaporation Rate: 0.29 (Butyl Acetate = 1)
Vapor Pressure: 2 mm Hg at 20°C (68°F)
Flash Point: 44°C (111°F)
Autoignition Temperature: 420°C (788°F)
Flammable Limits: 1.1% (LEL) - 9.4% (UEL)
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with strong oxidizing agents such as nitric acid, and strong bases.
Other Characteristics: Decomposes with heat and produces carbon monoxide.

IDENTIFICATION

Shipping Name(s): Cyclohexanone (USDOT & IMO)
Synonyms and Tradenames: Anone, Cyclohexyl Ketone, Pimelic Ketone, Ketohexamethylene, Hytrol O, Hexanon, Pimelin Ketone, Sextone, Anon, and Nadone. CAS Registry No: 108-94-1
Chemical Formula: $C_6H_{10}O$
Molecular Formula: $C_6H_{10}O$
UN/NA Designation: UN1915
IMO Designation: 3.3
RTECS Number: NIOSH/GW1050000
OHMTADS Number: Unavailable.
NFPA 704 Hazard Rating: 1 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Water-white to pale yellow
Odor Characteristics: Peppermint or acetone-like odor
Common Uses: Product is used as a solvent for waxes, vinyl resins, crude rubber, natural resins, and shellac. It is also used as a metal degreasing solvent for lacquers, resins, and insecticides, and PVC polymers and copolymers. Commercial uses include spot remover and degreaser for leather.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

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*Reportable Quantity (RQ) established. Refer to appendix I.

CYCLOHEXANONE

Class 3 (Flammable Liquid) or
Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.12-0.24 ppm

Unusual Hazards: Material will defat skin and cause transient corneal injury, central nervous system (CNS) depression. In high concentrations, it may cause death.

Time Weighted Average (TLV-TWA): 25 ppm

Short Term Exposure Limit (STEL): Unavailable.

IDLH: 5000 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong oxidizers, acids and bases.

HEALTH HAZARDS

Potential Health Effects: Cyclohexanone is irritating to the eyes, skin, nose and throat. It may be poisonous if inhaled or absorbed through the skin. Vapors may cause dizziness or suffocation. Skin contact with the liquid may cause defatting of the skin. Evidence suggests that skin permeation can occur in amounts capable of producing systemic toxicity. Excessive exposures may cause temporary central nervous system depression with anesthetic effects such as dizziness, drowsiness, fatigue, nausea, headache, respiratory failure, confusion, loss of coordination and loss of consciousness. Individuals with pre-existing conditions of the central nervous system or lungs may have increased susceptibility to the toxicity of excessive exposures.

Hazards of Skin Contact: Skin contact may cause skin irritation with rash, redness, burns, dermatitis, and swelling. Prolonged exposures may lead to skin burns, blistering and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, swelling, tearing, chemical conjunctivitis, or blurred vision. Prolonged eye contact may result in reversible corneal injury. Blindness can occur in some cases.

Inhalation Hazards: Inhalation may cause respiratory tract irritation, coughing, discomfort, dyspnea, and pulmonary edema. Prolonged exposures can produce central nervous system (CNS) effects such as narcosis, nausea, headache, dizziness, tremors, confusion, and fatigue.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, vomiting and abdominal pain.

FIRE HAZARDS

Lower Flammable Limit: 1.1%

Upper Flammable Limit: 9.4%

Behavior in Fire: Although cyclohexanone will not readily ignite, it will burn if exposed to sources of heat and flame. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff from fire control or dilution water may be flammable and/or toxic and cause environmental contamination.

Hazardous Decomposition Products: When heated to decomposition, material releases carbon monoxide and other irritating gases.

EXPLOSION HAZARDS

Explosive Potential: Slight to moderate in vapor form. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

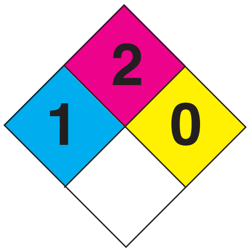
Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are butyl rubber and polyvinyl chloride (PVC). Structural firefighting protective clothing will provide a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited.

1915

CYCLOHEXANONE

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Skin contact with the liquid may cause redness, swelling, burning, dermatitis, and defatting of the skin. Excessive exposures may cause temporary central nervous system depression with anesthetic effects such as narcosis, dizziness, drowsiness, fatigue, nausea, tremors, headache, respiratory failure, confusion, loss of coordination and loss of consciousness. Prolonged eye contact may result in chemical conjunctivitis and reversible corneal injury. Inhalation may cause irritation to the upper respiratory passages, with coughing and discomfort, and pulmonary edema.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and DO NOT INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog), or alcohol-resistant foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be flammable and/or toxic.

SPILL RESPONSES

General Information: Cyclohexanone may cause environmental contamination. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Non-sparking tools and explosion-proof equipment are recommended to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, storm drains and waterways. Underflow dams are not an effective means to dike material since it mixes with water. As a result, recovery efforts from water borne releases are difficult. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing.
Maintain respiratory protection throughout the decontamination process.

CYCLOHEXANONE

Class 3 (Flammable Liquid) or Combustible Liquid

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, storm drains and waterways.

TECHNIQUE

MONITOR THE SITUATION...Due to its moderate vapor pressure, and tendency for vapors to hug the ground and accumulate in low lying and enclosed areas, the highest concentrations of material will usually be located at ground level. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and down wind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, storm drains, and waterways.

TECHNIQUE

FOAM...Firefighting foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, storm drains and waterways. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

CYCLOHEXANONE

Class 3 (Flammable Liquid) or Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, Cyclohexanone would be slowly lost by volatilization. Cyclohexanone is readily biodegradable, and therefore, would be expected to biodegrade in natural waters. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material readily mixes with water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms are not an effective means to recover spilled material since the material is water soluble. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material is water soluble and the material does not float on the surface of the water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

CYCLOHEXANONE

Class 3 (Flammable Liquid) or Combustible Liquid

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Cyclohexanone is estimated to be mobile in soil. In view of its moderate vapor pressure and low adsorption to soil, it would be expected to volatize from surface soil. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering sewers, waterways, or storm drains. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded to prevent the discharge of static electricity.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations.

January 1990

CYCLOPENTANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Cyclopentane is a clear, colorless, volatile, and flammable liquid hydrocarbon with a mild and sweet odor resembling gasoline. It is used as a solvent, motor fuel component, azeotropic distillation agent, and raw material and intermediate for making a variety of organic chemicals. Practically insoluble in water and lighter, cyclopentane will form a floating surface slick that will evaporate at an appreciable rate. Its flash point of – 35°F indicates that cyclopentane is easily ignited under all ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in ,pits, hollows, and depressions, particularly in warm weather. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.2 pounds per gallon.

Cyclopentane does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing agents, however, and may attack some forms of plastics, rubber, and coatings. Toxicity by all routes of exposure is generally low, but the volatility of the product indicates that high concentrations of cyclopentane vapors may be found in air. Products of combustion may include toxic constituents.

If cyclopentane is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; specific data are unavailable but it is likely that only very small amounts will dissolve in water.

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and other hydrocarbon solvents.

Specific Gravity (Liquid): 0.745–0.746 at 68°F (20°C)

Boiling Point: 120.6 –120.7°F (49.2 – 49.3°C) at 1 atm.

Melting Point: –137.9 to –135.9°F (– 94.4 to – 93.3°C)

Freezing Point: See melting point

Molecular Weight: 70.14

Heat of Combustion: –11,110 cal/g

Vapor Pressure: Approx. 274 mm Hg (5.3 psia) at 68°F (20°C); 400 mm Hg (7.73 psia) at 87.8°F (31°C)

Flash Point: –35°F (–37.2°C), closed cup

Autoignition Temperature: 682–716°F (361–380°C)

Burning Rate: 7.9 mm/minute

Stability: Stable

Corrosiveness: Noncorrosive to usual metals but may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react or ignite in contact with strong oxidizing agents or materials.

IDENTIFICATION

Shipping Names: Cyclopentane (USDOT and IMO)

Synonyms and Tradenames: Pentamethylene

Chemical Formula: $(CH_2)_5$ (ring structure)

Constituent Components (% each): Various grades are 60% or more cyclopentane with remainder consisting of n-hexane, n-pentane, methylcyclopentane, 2,2dimethylbutane, and other hydrocarbons with similar boiling points. Highly impure products may have somewhat different physical properties than those given here for the relatively pure substance.

49 STCC: 49 081 35

UN/NA Designation: UN1146

IMO Designation: 3.1, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Mild; sweet; like gasoline

Common Uses: Solvent; motor fuel component; azeotropic distillation agent; raw material and intermediate for making a variety of organic chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

CYCLOPETANE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly volatile and flammable liquid with heavier than air vapors that may persist in pits, hollows, and depressions at times.

Short Term Exposure Limits (STEL). **Unavailable**

Time Weighted Average (TLV-TWA): 600 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided. There is a possibility that cyclopentane is a weak sensitizer of the heart to epinephrine.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid cyclopentane may result in drying and cracking of the skin as well as moderate irritation due to the defatting action of the product and possibly redness and blistering. Contact of liquid cyclopentane with the eyes may cause slight irritation with some pain, inflammation of the iris and mucous membranes, redness, and tearing. Do not wear contact lenses when working with cyclopentane.

Hazards of Inhalation: Exposure to high levels of cyclopentane vapors in air may cause eye, nose, and respiratory tract irritation. Inhalation of very high concentrations in air may cause narcosis and central nervous system depression with symptoms including dizziness, drowsiness, disorientation, headache, excitation, incoordination, stupor, nausea, vomiting, difficult breathing, respiratory and cardiac effects, loss of equilibrium, unconsciousness, coma, and possibly death in severe cases. The margin between onset of narcosis and death is very narrow and may be nonexistent based on animal experiments. A concentration of about 38,300 ppm of cyclopentane in air has been reported to be lethal to mice without the duration of exposure being recorded. For purposes on comparison, note that exposure to 18,000 ppm of cyclopropane in air for 39 minutes is lethal to mice; 26,600 ppm of cyclohexane is lethal to rabbits after 60 minute exposures in laboratory experiments.

Hazards of Ingestion: Ingestion of cyclopentane may cause gastrointestinal irritation. Severe diarrhea and vascular collapse resulting in heart, lung, liver, and brain degeneration have been reported upon oral administration of alicyclic hydrocarbons such as cyclopentane to animals. Effects may also include depression of the central nervous system with symptoms resembling those of inhalation. Aspiration of cyclopentane into the lungs during vomiting may cause pulmonary edema and chemical pneumonitis with potentially severe consequences. Based on the effects of similar substances, it is possible that pulmonary edema may be delayed in onset.

FIRE HAZARDS

Lower Flammable Limit: 1.1% or 1.5%; reported values vary

Upper Flammable Limit: 8.7%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined; reported to produce acrid smoke and fumes, carbon monoxide, carbon dioxide, and various hydrocarbons which may be toxic.

EXPLOSION HAZARDS

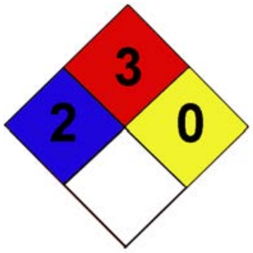
Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. There is some known potential for unconfined vapor clouds of very similar substances (primarily cyclohexane) to explode if ignited.

1146

CYCLOPETANE
Class 3 (Flammable Liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Clothing materials that may be compatible for cyclohexane include nitrile rubber, neoprene, Viton, chlorinated polyethylene, and Teflon. Some of these may also be suitable for use with the very similar cyclopentane.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 600 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; symptoms of narcosis and central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for **Ingestion:** Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, Halon, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of cyclopentane may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that cyclopentane is a highly volatile and flammable liquid that may evaporate rapidly and has heavier than air vapors.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Cyclopentane spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

CYCLOPETANE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to cyclopentane vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of cyclopentane from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of cyclopentane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Cyclopentane may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained cyclopentane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, vermiculite, perlite, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

CYCLOPETANE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL.

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Although cyclopentane will evaporate fairly rapidly from water surfaces, time or cold weather conditions may permit application of the oil spill containment and cleanup measures described below in some but not all cases. Only small amounts of cyclopentane, if any, can be expected to dissolve in water.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 – 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

CYCLOPETANE
Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating cyclopentane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with cyclopentane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: This and the following potential spill responses should be considered only where critical water resources have been impacted and it is desired to remove all traces of the spilled product. Consult qualified experts for advice where necessary.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

DENATURED ALCOHOL

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Denatured alcohol is a flammable, colorless liquid with a slightly pungent odor like alcohol. It is primarily ethyl alcohol (reportedly 80-95%) containing additives of 1 to 2 percent each to prevent its use as a beverage. These additives can cause it to have a subsidiary hazard of poison and thus the reason for the two identification numbers, NA1987 having the greater toxicity hazard. It has several uses but is used extensively as a solvent in the manufacture of varnishes and perfumes. It is soluble in water. Its flash point of 55ºF indicates that the product is easily ignited under a wide range of ambient temperature conditions. Accumulations of vapor from warmed liquid in confined spaces such as buildings or sewers may result in explosions if ignited. Denatured alcohol vapors are heavier than air and may travel considerable distances to a source of ignition and flash back. The product weighs approximately 6.8 pounds per gallon.

Denatured alcohol does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong acid and oxidizing materials. The primary routes of exposure are through inhalation and ingestion. The products of combustion may include carbon monoxide and carbon dioxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Complete

Solubility in Other Chemicals: Soluble in other alcohols.

Specific Gravity (Liquid): 0.8175

Vapor Density: 1.6

Boiling Point: 173ºF (78ºC)

Melting Point: -173ºF (-114ºC)

Freezing Point: Unavailable

Molecular Weight: 46.07

Heat of Combustion: Unavailable

Evaporation Rate (butyl acetate=1): 1.6, 2.7 and 3.3 are all reported values.

Vapor Pressure: 43 mmHg

Flash Point: 55°F (13ºC)

Autoignition Temperature: 793ºF (422°C)

Burning Rate: Unavailable

Flammable Limits: 3.3% (LEL) - 19% (UEL)

Stability: Stable

Polymerization Potential: Will not occur.

pH: Unavailable

Corrosiveness: Unavailable, most likely non-corrosive.

Reactivity with Water: No reaction.

Reactivity and Incompatibility: Avoid contact with strong acids and strong oxidizers such as nitric acid, hydrogen peroxide, acetyl chloride, potassium dioxide, bromine pentafluoride, acetyl bromide, acetyl chloride, platinum and sodium. Product can decompose at elevated temperatures. Reacts slowly with calcium hypochlorite, silver oxide and ammonia, causing fire and explosion hazard.

IDENTIFICATION

Shipping Name(s): Denatured alcohol (USDOT); Ethanol or Ethanol solutions (IMO)

Synonyms and Tradenames: Ethyl alcohol; Alcohol; Cologne spirit; Ethanol; EtOH; Grain alcohol.

CAS Registry No.: 64-17-5

Chemical Formula: C_2H_5OH or CH_3CH_2OH

Constituent Components (% each): Varies, generally close to 80-95% pure.

UN/NA Designation: NA1986 or NA1987 (USDOT); UN1170 (IMO)

IMO Designation: 3.2 or 3.3, Flammable liquids

RTECS Number: KQ6300000

NFPA 704 Hazard Rating: 0(Health): 3(Flammability): 0(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless, clear

Odor Characteristics: Slightly pungent odor like alcohol.

Reportable Quantity: See appendix I.

Common Uses: Ethanol is used extensively as a solvent in the manufacture of varnishes and perfumes; as a preservative for biological specimens; in the preparation of essences and flavorings; in many medicines and drugs; as a disinfectant and in tinctures (e.g., tincture of iodine); laboratory reagant and as a fuel and gasoline additive.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

DENATURED ALCOHOL

Class 3 (Flammable Liquid) or
Combustible Liquid

or

* 1986 or 1987

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 100-180 ppm (recognition), reports vary widely.

Unusual Hazards: None

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1000 ppm (1900 mg/m^3) (for ethyl alcohol)

Ceiling (C) Limit: Unavailable

IDLH: 3300 ppm or 10% LEL (for ethyl alcohol)

Conditions to Avoid: Heat, fire, and sparks, contact with incompatible materials, runoff to sewers or water bodies, inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Health hazards are generally low unless combined with other harmful products.

Hazards of Skin or Eye Contact: Essentially non-irritating to skin, however, prolonged or repeated skin contact may cause drying, cracking and irritation of the skin. Contact with the eyes may cause irritation.

Hazards of Inhalation: Prolonged exposure to high vapor concentrations in air may cause drowsiness and irritation of the eyes, respiratory tract and lungs.

Hazards of Ingestion: Ingestion toxicity considered to be low, may include dizziness, headache and drowsiness.

FIRE HAZARDS

Lower Flammable Limit: 3.4%

Upper Flammable Limit: 19%

Behavior in Fire: Flammable liquid. Material is flammable and will very likely ignite if exposed to sources of heat. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Vapors may cause a flash fire or ignite explosively. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers exposed to prolonged heat and flame may violently rupture.

Hazardous Combustion Products: Products of decomposition products may include carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Explosions may result if vapors of warm liquid are ignited in a confined area. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas where vapors can accumulate and present an explosive hazard. Containers exposed to prolonged heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

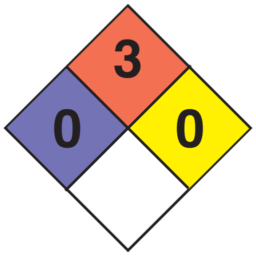
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge may suffice.

1986

1987

DENATURED ALCOHOL

Class 3 (Flammable Liquid) or Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention if symptoms persist. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Get medical attention if symptoms persist. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek medical assistance if symptoms persist. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Reports vary on whether or not to induce vomiting. Seek medical advice by a physician on whether or not to inducing vomiting. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Use dry chemical, alcohol type concentrate foam, carbon dioxide, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of denatured alcohol may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

DENATURED ALCOHOL

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to denatured alcohol vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

ALCOHOL TYPE CONCENTRATE FOAM . . . Alcohol type concentrate foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material has a high potential for mobility in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

DENATURED ALCOHOL
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

This page may be used for notes.

March 1995

DIBORANE
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Diborane is a colorless and highly flammable compressed or liquefied gas with a foul, musty, sickly sweet odor that is repulsive and nauseating. It is primarily used in making plastics, rubber, rocket propellants, electronic semiconductors, and other chemicals. The product has a flash point of – 90°F or below, may ignite spontaneously in moist air at temperatures of 100 – 125°F when pure, and may ignite at even lower temperatures when contaminated with other substances. Due to its instability, pure diborane is often handled in cylinders shipped in dry ice and or diluted with other gases. Diborane gas is heavier than air when cold and in any case may travel a considerable distance to a source of ignition and flash back if it does not self-ignite first. Accumulations of gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 3.5 pounds per gallon at its boiling point and only 1.5 pounds per gallon at 63°F or so.

Diborane slowly decomposes at room temperature producing higher boranes, other boron hydrides, and flammable and potentially explosive hydrogen gas. Very high temperatures produce hydrogen and boron. Reactions with water quickly produce hydrogen and boric acid while producing heat, and reactions with a variety of other chemicals may result in explosions or otherwise violent reactions. Toxicity of the product is extremely high by inhalation. Products of combustion are also considered toxic.

Downwind evacuation should be considered if diborane is leaking (not on fire) until properly-equipped responders have evaluated the hazard. If a fire becomes uncontrollable or a bulk container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the containers should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.

Solubility in Other Chemicals: Soluble in carbon disulfide, ammonium hydroxide, and concentrated sulfuric acid.

Specific Gravity (Liquid): 0.18 at 62.6°F (17°C); 0.42 at boiling point.

Boiling Point: –135 to –134.5°F (– 92.8 to – 92.5°C) at 1 atm.

Melting Point: – 265.9 to – 264.8°F (–165.5 to –164.9°C)

Freezing Point: See melting point

Molecular Weight: 27.7

Heat of Combustion: Unavailable

Vapor Pressure: 39.52 atm (580.55 psia) at 62.1°F (16.7°C), this being the critical point.

Flash Point: – 90°F (– 67.8°C) or below; reported values vary.

Autoignition Temperature: Ignites spontaneously in moist air at 100 –125°F (38 – 52°C); at lower temperatures if contaminated.

Burning Rate: Unavailable

Stability: Decomposes slowly under normal transportation conditions. May ignite spontaneously in moist air at room temperature. Decomposes at red heat to boron and hydrogen; to hydrogen, higher boranes, and other boron hydrides at lower temperatures. Some decompositions may be violent.

Corrosiveness: Compatible with most metals. May attack some forms of plastics, rubber, coatings, greases, and lubricants.

Reactivity with Water: Decomposes rapidly in water to form hydrogen and boric acid while generating heat.

Reactivity with Other Chemicals: Reacts slowly with bromine and explosively with chlorine to form boron halides. Reacts violently with halogenated hydrocarbons (including extinguishing agents) and oxidizing materials. Reacts to form spontaneously ignitable mixtures with aluminum, lithium, fuming nitric acid, or phosphorus trifluoride. May explode on contact with carbon tetrachloride while burning, in contact with nitrogen trifluoride at low temperatures, or in contact with oxygen. Reacts with many oxidized surfaces.

IDENTIFICATION

Shipping Names: Diborane, compressed (USDOT & IMO); diborane mixtures (USDOT)

Synonyms and Tradenames: Boroethane; diboron hexahydride; diborane (6); boron hydride.

Chemical Formula: B_2H_6

Constituent Components (% each): 95% or more pure; may also be shipped with diluent gas like hydrogen, argon, nitrogen, or helium to retard decomposition and otherwise reduce hazards.

UN/NA Designation: UN1911

IMO Designation: 2.3, poison gas

Physical State As Shipped: Liquefied compressed gas or compressed gas

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Repulsive; sickly sweet; nauseating; pungent; musty; foul

Common Uses: Polymerization catalyst; rubber vulcanizer; reducing agent; in rocket propellants; doping agent for electronic semiconductors; in making other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

DIBORANE

Poison Gas
(Division 2.3)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Recognized at 3.3 ppm in air but quickly deadens sense of smell.

Unusual Hazards: Extremely toxic, reactive, flammable, potentially explosive, and volatile substance with many unusual characteristics. Gases may be heavier than air when cold. May ignite spontaneously in air.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.1 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard by far is from inhalation of the dangerous levels of diborane that may be present in air in the spill and over considerable distances downwind. Direct contact with liquid diborane is also to be strictly avoided.

Hazards of Skin or Eye Contact: Diborane gas has no significant effect on the skin or mucous membranes but high concentrations in air may irritate the eyes. One authority reports that contact with the liquid may cause local inflammation, blisters, redness, and swelling. Due to the low temperatures involved, frostbite must also be deemed possible. Do not wear contact lenses when working with this material.

Hazards of Inhalation: Low concentrations in air may cause tightness in the chest, cough, difficult breathing, chest pain, headache, dizziness, chills, possible fever, weakness, fatigue, and possible tremors. Higher levels may cause lung hemorrhage, possible damage to the liver and kidneys, and pulmonary edema which may be delayed in onset and have severe consequences. Concentrations of 29 and 50 ppm in air were respectively fatal to 50% of mice and rats in 4 hours in laboratory experiments. One manufacturer reports that 159 molar ppm is fatal to 50% of humans in 15 minutes.

Hazards of Ingestion: Due to its low boiling point and high reactivity, diborane itself is unlikely to be ingested.

FIRE HAZARDS

Lower Flammable Limit (LFL): 0.8% or 0.9%; reported values vary.

Upper Flammable Limit (UFL): 88% or 98%; reported values vary.

Behavior in Fire: Flammable compressed gas or liquefied compressed gas will generate large quantities of flammable and toxic gas upon release. Gas is heavier than air when cold and in any case may travel a considerable distance to a source of ignition and flash back or explode. Containers may rupture violently in fire.

Hazardous Combustion Products: Toxic; may include boric acid, boron oxides, other boron hydrides, and higher boranes.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. May also explode when mixed rapidly with air; mixtures of 2 – 25% detonate when sparked; 10% mixture gives most violent detonation. Some products of decomposition, such as tetraborane, may be shock sensitive, as may diborane itself to some extent. Contact or mixture of diborane with certain other chemicals may result in an explosion. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection as necessary from direct contact with liquid diborane, cold gas streams, or cold containers of the product. This may include rubber boots, gloves, face shields, splash- proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high gas or fume concentrations in air during fires according to one authority.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 0.1 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1911

DIBORANE
Poison Gas
(Division 2.3)

FIRST AID

Nonspecifc Symptoms: Headache, weakness, difficult breathing, dizziness, fatigue, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention as necessary. Do not use hot water or rub affected bodily tissues if frostbite has occurred.

FIRE RESPONSE

Extinguishing Materials: Stop flow of diborane or else let fire burn while cooling container and surroundings with water spray or fog. Do not use halogenated agents (halons) under any circumstances.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit where necessary if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that diborane reacts with water to form hydrogen gas and boric acid.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water containing boric acid. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground and electrically bond piping and equipment. Note that design of piping and equipment for undiluted diborane is highly specialized and requires experienced professionals. Take the extremely toxic, flammable, reactive, and potentially explosive nature of diborane into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Diborane discharges may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large amounts are involved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

DIBORANE
Poison Gas
(Division 2.3)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to diborane gas or decomposition products in air may accelerate their dispersal in the atmosphere. Apply water with caution, keeping in mind that diborane reacts with water to form flammable hydrogen gas and boric acid, but that this reaction may actually have benefits at times in reducing overall hazards and is not described as being violent by any authority.

CONSEQUENCE

Water runoff may contain boric acid and other chemicals from contact with airborne gases and fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquids containing diborane reaction or decomposition products may be contained by building dikes using soil, sand or other materials where necessary. Note that the boric acid that remains after reaction of diborane with water may be toxic to some plant life but is not otherwise a significant hazardous material. Decisions on containment and treatment or recovery must be made on a case by case basis. Seek advice from qualified experts. Note that any liquid diborane spilled will rapidly vaporize but may also be temporarily contained where necessry to prevent spread of contamination.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain contaminated liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

DIBORANE
Poison Gas
(Division 2.3)

TECHNIQUE

ABSORPTION . . . Spreading of contaminated liquids may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify contaminated liquids to less hazardous substances.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residues may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable gases or vapors in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination where necessary due to the presence of boric acid or other contaminants in the water. Seek advice from qualified experts.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

DIBORANE
Poison Gas
(Division 2.3)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Cation exchangers may also be effective.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

DI-n-BUTYLAMINE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Di-n-butylamine is colorless, corrosive, combustible liquid with a fishy odor resembling ammonia. It is used for making a variety of products such as corrosion inhibitors, pharmaceuticals, inks, paper, leather, photographic chemicals, plasticizers, fuel and lubricant additives, dyes, and insecticides, among others. Only slightly soluble in water and lighter, it can be expected to form a surface slick that dissolves at a relatively slow rate. Its lowest reported flash point considered to be accurate is 117°F and indicates that high ambient temperature conditions or some degree of heating is necessary before the product can be ignited easily. Accumulations of vapor from warmed liquid in confined spaces such as buildings or sewers may explode if ignited. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.3 – 6.4 pounds per gallon.

Di-n-butylamine does not react with water and is stable in normal transportation. It is known to be incompatible with acids and oxidizing agents, and as an aliphatic amine, is likely to be reactive with a variety of other chemical substances. Corrosive to some metals, the product may also attack some types of plastics, rubber and coatings, and is also highly corrosive to all bodily tissues. Products of combustion include toxic constituents.

If di-n-butylamine is leaking (not on fire), downwind evacuation should be considered on a case-by-case basis until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.47 g/100 g water or 3100 mg/l at 68°F (20°C); reported values vary somewhat.
Solubility in Other Chemicals: Soluble in most common organic solvents including alcohol, acetone, ether, benzene, and other hydrocarbons.
Specific Gravity (Liquid): 0.759 – 0.768 at 68°F (20°C)
Boiling Point: 318.2 –320°F (159 –160°C) at 1 atm.
Melting Point: –79.6 to – 74.2°F (– 62 to – 59°C)
Freezing Point: See melting point
Molecular Weight: 129.25
Heat of Combustion: – 10,440 cal/g
Vapor Pressure: 2 mm Hg (0.0387 psia) at 68°F (20°C)
Flash Point: 117–125°F (47.2 – 51.7°C), closed cup; 125 – 135°F (51.7 – 57.2°C), open cup
Autoignition Temperature: Unavailable
Burning Rate: 5.84 mm/minute
Stability: Stable
Corrosiveness: May corrode some metals and attack some forms of plastics, rubber, and coatings. Store in carbon or stainless steel, cast iron, aluminum, phenolic-lined steel, nickel, or tinned iron. Zinc, galvanized steel, copper, or copper alloys are not generally satisfactory for amines.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Specifically reported to be incompatible with acids and oxidizing agents. Amines in general are also often reactive with aldehydes, halogenated organics, isocyanates, elemental alkali metals, peroxides, epoxides, strong reducing agents, and possibly dithiocarbamates. Similar compounds are incompatible with mercury, nitrous oxide, and nitrites.

IDENTIFICATION

Shipping Names: Di-(n-butyl)amine (USDOT and IMO)
Synonyms and Tradenames: Dibutylamine; n-dibutylamine; n-butyl – 1-butanamine
Chemical Formula: $(CH_3CH_2CH_2CH_2)_2NH$
Constituent Components (% each): Relatively pure with possibly small amounts of n-butylamine, n-butylidenebutylamine, n-butanol, and/or tri-n-butylamine
UN/NA Designation: UN2248
IMO: Designation: 8, Corrosive
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Like ammonia or amine; fishy
Common Uses: Mfg. of corrosion inhibitors, emulsifiers, rubber accelerators, pharmaceuticals, inks, paper, leather, photographic chemicals, plasticizers, fuel and lubricant additives, dyes, insecticides, flotation agents, curing agents, and other products. Inhibitor for butadiene.

DI-n-BUTYLAMINE

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.48 ppm for 100% odor recognition; may be perceived as low as 0.08 ppm

Unusual Hazards: Corrosive and combustible liquid of comparatively low volatility.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and over some distance downwind. Direct physical contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Skin contact with liquid di-n-butylamine may cause severe irritation and/or blisters and chemical burns. There is an unconfirmed possibility of allergic skin sensitization. Contact of liquid di-n-butylamine with the eyes may result in severe damage resulting in blindness.

Hazards of Inhalation: Vapors of di-n-butylamine are irritating to the eyes, nose, throat, and lungs. High levels in air may cause headache, dizziness, faintness, anxiety, coughing, difficult breathing, and the possibility of delayed pulmonary edema or chemical pneumonitis with possibly severe consequences. Exposure to 500 ppm in air for four hours was lethal to 100% of rats in laboratory experiments, while 250 ppm proved non-lethal. (Note: The saturated vapor concentration of di-n-butylamine in air at 68°F is approximately 2630 ppm.)

Hazards of Ingestion: Ingestion may cause irritation and burning of the mouth and stomach, nausea, and vomiting. There may be potential for aspiration into the lungs during vomiting to result in delayed pulmonary edema and chemical pneumonitis with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 1.1%.

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but may be somewhat difficult to ignite unless warmed. There is some limited possibility that containers may rupture violently in fire.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide, various hydrocarbons, and highly toxic oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from warm liquid are ignited in a confined area. There is some limited possibility that containers may rupture violently in fire.

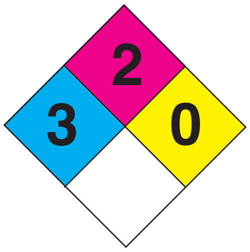
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases to prevent contact with high vapor or fume concentrations that may occur in air under fire conditions. Compatible materials may include polyvinyl alcohol and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For relatively low concentrations, a gas mask with chin-style or front or back mounted canister providing protection against di-n-butylamine or a chemical cartridge respirator with a full facepiece providing protection against di-n-butylamine within the use limitations of these devices.

2248

DI-n-BUTYLAMINE
Class 8 (Corrosive Material)



FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues; headache, dizziness, coughing, nausea, difficult breathing, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective. (Note: Authorities are divided as to whether alcohol or standard foam should be used. It is likely that both types are suitable to some degree.)

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit where necessary if contact with material or dense fumes/smoke is anticipated under fire conditions. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other down stream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that di-n-butylamine is highly corrosive to bodily tissues. Although considered a combustible liquid, its flash point is not much above high ambient temperatures that may be encountered in some spill situations.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Di-n-butylamine spills may expose downwind areas to toxic or irritating concentrations over considerable distances in some cases, particularly if large quantities have spilled under high ambient temperature conditions.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Di-n-butylamine may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills under low to moderate ambient temperature conditions.

CONSEQUENCE

Hazardous levels of di-n-butylamine in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

DI-n-BUTYLAMINE
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to di-n-butylamine vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of di-n-butylamine from contact with its air borne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and over fill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of di-n-butylamine vapors into the atmosphere. (Note: Authorities are divided as to whether alcohol or standard foam should be used. It is likely that both types are suitable to some degree.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Di-n-butylamine may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained di-n-butylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, perlite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

DI-n-BUTYLAMINE
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area under high temperature conditions may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Di-n-butylamine will float on water while dissolving at a relatively slow rate to form an alkaline solution.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 – 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

DI-n-BUTYLAMINE
Corrosive

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams or small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating di-n-butylamine.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location.

TECHNIQUE

ABSORPTION . . . Commercial sorbent materials compatible with di-n-butylamine may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause over flow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

October 1993

o-DICHLOROBENZENE
Division 6.1(Poisonous Material)

GENERAL INFORMATION

o-Dichlorobenzene is a colorless to pale yellow liquid with an odor that is variably described as mild, pleasant, disagreeable, pungent, aromatic, and possibly resembling mothballs. It is practically insoluble in water and heavier, so may be expected to sink to the bottom of a body of water and dissolve at a very slow rate. The substance must be preheated before it can be easily ignited. Vapors evolved from liquid o-dichlorobenzene heated above its flash point may travel to a source of ignition and flash back. Similarly, accumulations of such vapors may explode if ignited in confined spaces such as buildings or sewers. The product weighs approximately 10.9 pounds per gallon.

o-Dichlorobenzene does not react with water and is stable in normal transportation. The material is generally considered to be non-corrosive to metals, but it can react with aluminum (see below), and possibly other active metals such as zinc or magnesium, and may attack various forms of plastics, rubber, and coatings. There is an increased risk of vigorous reaction, fire and/or explosion in the presence of strong oxidizing agents and o-dichlorobenzene is otherwise reactive with strong acids and a variety of other chemical substances. Toxicity of the substance is generally low to moderate by direct contact and ingestion but quite high via inhalation. Products of combustion or thermal decomposition may include irritating, corrosive, and/or toxic substances such as hydrogen chloride, hydrochloric acid, chlorine, chlorocarbons, carbon monoxide, carbon dioxide, extremely toxic phosgene, and possibly other harmful substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if o-dichlorobenzene is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble.
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, carbon tetrachloride, ether, ligroine, and other organic solvents.
Specific Gravity (Liquid): 1.298 - 1.307 at 68°F (20°C).
Boiling Point: 341.6°F (172°C) - 361.4°F (183°C) at 1 atm.
Melting Point: 0.3 - 1.4°F (-17.6 to - 17°C).
Freezing Point: See melting point.
Molecular Weight: 147.0.
Heat of Combustion: -4,427 cal/g.
Vapor Pressure: 1.0 - 1.2 mm Hg at 68°F (20°C); 5.0 mm Hg at 114.8°F (46°C).
Flash Point: 151 - 160°F (66.1 - 71.1°C), closed-cup; 155 - 165.9°F (73.9 - 74.4°C), open-cup.
Autoignition Temperature: 1,198°F (647.8°C).
Burning Rate: 1.3 mm/minute.
Stability: Stable.
Corrosiveness: Generally considered non-corrosive to many common metals but is not compatible with many rubbers and plastics. Can react with aluminum (see below). Recommended materials include steel, stainless steel, Viton, polyethylene, and Teflon for equipment, hoses, etc.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Slow reaction with aluminum has potential to cause rupture or explosion of sealed aluminum containers, particularly if some amounts of aluminum chloride are present. May react vigorously with strong oxidizing agents. Incompatible with strong acids. Reactions of halogenated organic materials such as o-dichlorobenzene with cyanides, mercaptans or other organic sulfides typically generate heat, while those with mineral acids, amines, azo compounds, hydrazines, caustics or nitrides commonly evolve heat and toxic or flammable gases. Reactions with oxidizing mineral acids may generate heat, toxic gases and fires. Those with alkali or alkaline earth metals, certain other chemically active elemental metals like aluminum, zinc or magnesium, organic peroxides or hydroperoxides, or strong reducing agents typically result in heat generation and explosions and/or fires.

IDENTIFICATION

Shipping Names: o-Dichlorobenzene.
Synonyms and Tradenames: Benzene, 1,2-dichloro-; 1,2-dichlorobenzene; dichlorobenzene, ortho-; ortho-dichlorobenzene; ortho-dichlorobenzol; o-dichlorobenzol; DCB; o-DCB; ODB; ODCB; and numerous tradenames.
Chemical Formula: o-$C_6H_4Cl_2$ or 1,2-$C_6H_4Cl_2$.
Constituent Components (% each): The purest grades contain close to 100% ortho-dichlorobenzene. Some products apparently contain about 80 to 85% of the ortho isomer with the remainder consisting mostly of the para and meta isomers of dichlorobenzene. The crudest commercial grade product identified contains 48.8% of the ortho isomer, and 28% of the para isomer.
UN/NA Designation: UN1591.
IMO Designation: 6.1, poisonous material.
Physical State As Shipped: Liquid.
Physical State As Released: Usually liquid but may solidify at low temperatures.
Color As Shipped: Colorless to pale yellow.
Odor Characteristics: Reported as mild, pleasant, disagreeable, pungent, aromatic, and possibly resembling mothballs.
Common Uses: Solvent for waxes, gums, resins, tars, and rubbers; insecticide for termites and other pests; used to make other chemicals such as dyes, to degrease hides and wool, in industrial odor control, and metal polishes.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

o-DICHLOROBENZENE
Division 6.1 (Poisonous Material)

PG III can replace
the word poison

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Some sources indicate most people can detect odor at 2 - 4 ppm in air. Others list an odor threshold of 50 ppm. Vapors are reported as strong and irritating at 100 ppm.

Unusual Hazards: Reacts in an unusual manner with aluminum and possibly other active metals. Vapors are highly toxic if inhaled.

Short Term Exposure Limit (STEL): (Skin) 50 ppm for 15 minutes (ACGIH, 1992 - 93).

Time Weighted Average (TWA) Limit: (Skin) 25 ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93).

Ceiling (C) Limit: 50 ppm absolute ceiling limit (OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to o-dichlorobenzene vapors that may be present in air in the immediate spill area and over some distance downwind. Ingestion and direct contact should also be avoided. Generally, long-term exposures to dichlorobenzenes are suspected of playing a role in causing leukemia in humans. Based on animal data, significant exposures may cause injury to the testes of males and fetal abnormalities. There is a possibility, based on experience with similar chemicals, that people who ingest or have ingested alcohol may be at much greater risk of kidney and/or liver injury when exposed to this material.

Hazards of Skin or Eye Contact: Vapors cause noticeable eye irritation at concentrations of 25 to 30 ppm in air; exposure to 60 to 100 ppm may cause pain if longer than a few minutes in duration. Contact of the eyes with liquid o-dichlorobenzene may cause pain, distress, irritation, and possible tissue damage that is likely to heal fairly quickly, especially if the substance is promptly removed. Application of the liquid for 15 minutes to the skin of humans caused a burning sensation which intensified with exposure up to one hour and abated when the liquid was removed. The skin became red and blistered; a brown stain developed and persisted for 3 months. The skin of some people may become sensitized upon repeated or prolonged exposure such that they become allergic. Excessive or repeated or prolonged skin contact has been shown to cause liver and kidney damage and death via absorption through the skin in animal studies. Effects of significant absorption through the skin are reported similar to those of excessive inhalation. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: The vapors of o-dichlorobenzene are irritating to the nose, throat, and upper respiratory tract. Exposure to high concentrations in air may cause narcosis and central nervous depression with symptoms variably including coughing, difficult breathing, chest pains, faintness, dizziness, headache, fatigue, drowsiness, nausea, vomiting, trembling, low blood pressure, unconsciousness, and possibly death. Non-lethal exposures may result in damage to the lungs, liver, and kidneys; the effects on the latter two organs may not be immediately evident. Accidental exposure of workers for 4 days resulted in significant alterations to leukocytes (white blood cells) which returned to normal in about 6 months. Severe toxic effects are reported to be seen in humans at a level of 300 ppm in one hour or less. Dichlorobenzenes in general may cause other effects such as swelling of the eyes, hands and feet. The NIOSH IDLH (1990) for o-dichlorobenzene is 1000 ppm. The saturated vapor concentration directly over a pool of liquid o-dichlorobenzene is about 1,320 to 1,580 ppm at 68°F (20°C), 2,500 ppm at 86°F (30°C), and 6,580 ppm at 114.8°F (46°C).

Hazards of Ingestion: Many effects of ingesting o-dichlorobenzene are similar to those associated with inhalation. Other reported symptoms include increased salivation and lacrimation, initial excitation followed by sleepiness, abdominal pain, nausea, vomiting, gastrointestinal irritation, shock, partial or full paralysis of the lower extremities, and possibly death due to paralysis of the respiratory center in extreme cases. Autopsies have shown liver and kidney injury, vascular disorders, hemorrhages into the submucosa of the stomach, and slight edema of the brain.

FIRE HAZARDS

Lower Flammable Limit: Most sources say 2%.

Upper Flammable Limit: Most sources say 9.2% to 12%.

Behavior in Fire: Combustible liquid. May require some degree of preheating to be easily ignited. May generate flammable vapors upon release if heated above its flash point. Such vapors have some potential to travel to a source of ignition and flash back. One authority reports that fires may be smoky due to incomplete combustion. There is some potential for containers to rupture in a fire (see Explosiveness below).

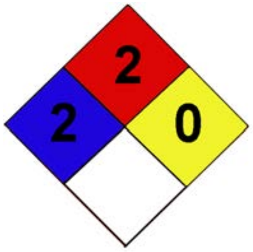
Hazardous Combustion Products: Not well-defined. Predicted by various sources to include irritating, corrosive, and/or toxic gases and fumes of hydrogen chloride, chlorine, chlorocarbons, carbon monoxide, carbon dioxide, extremely toxic phosgene, and possibly other harmful substances.

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors from hot liquid are ignited in a confined area. Despite the high boiling point and low vapor pressure of o-dichlorobenzene, some authorities warn that containers exposed to fire or excessive heat may rupture violently. (See Chemical Reactivity Data.)

1591

o-DICHLOROBENZENE
Division 6.1 (Poisonous Material)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment for normal operations should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the chemical. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. For fire or spill conditions, a fully encapsulating suit with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor, fume, or combustion product concentrations in air. Compatible materials for o-dichlorobenzene itself may include Viton and Viton/neoprene according to expert sources. Others report that Buna-N, neoprene, polyethylene/ ethylene vinyl alcohol/polyethylene, polyethylene, and Teflon may provide varying degrees of acceptable performance. Many factors affect the suitability of a material for a given application.

Respiratory Protection: For unknown concentrations, fire fighting, general use, or high concentrations (above 1,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a chemical cartridge respirator with a full facepiece (1,000 ppm or less) and organic vapor cartridge(s), or any powered air-purifying respirator (1,000 ppm or less) equipped with organic vapor cartridge(s) and eye protection within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, nose, throat, or respiratory system; narcosis and central nervous system depression; low blood pressure, salivation, lacrimation, nausea, vomiting, abdominal pain, shock, paralysis of extremities, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. At least one authority recommends that stimulants such as epinephrine (i.e., adrenalin) not be administered since they may increase myocardial irritability. Do not permit consumption of alcohol after any exposure to this substance.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if eye contact has occurred or promptly if skin irritation persists after washing. See comment above about alcohol consumption if skin contact was prolonged before treatment.

First Aid for Ingestion: Get immediate medical attention. Seek professional medical advice before inducing vomiting. If medical attention is not immediately available and if victim is conscious, administer large quantities of water (or dose of syrup of ipecac) and induce vomiting. Do not make an unconscious person vomit. If vomiting occurs naturally or is induced, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. See comment above about alcohol consumption and the use of stimulants.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, and regular foam are recommended by most authorities.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective clothing if contact with material or dense fumes/smoke is expected. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer

SPILL RESPONSES *(CONTINUED)*

lines as deemed necessary prior to use. Be advised there is a possibility that discharge of a carbon dioxide fire extinguisher at the point of leakage of liquid o-dichlorobenzene has the potential to solidify the product and stop the leak in some cases, at least temporarily. Other means of attempting to solidify the leaking liquid via cooling may also work. Whether or not the "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the container and its temperature. Use professional judgment in attempting this type of response action. Take the combustibility, toxicity, and reactivity of o-dichlorobenzene into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. o-Dichlorobenzene discharges may expose downwind areas to toxic and possibly flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm or hot weather or the liquid is somehow heated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION. . . Liquid o-dichlorobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled or in cold weather.

CONSEQUENCE

Hazardous levels of o-dichlorobenzene may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to o-dichlorobenzene vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of o-dichlorobenzene from contact with its airborne vapors.

MITIGATION

Where deemed necessary, contain contaminated water and remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of o-dichlorobenzene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . o-Dichlorobenzene is heavier than water and practically insoluble. Gentle application of a light spray of water onto the surface of confined pools of the liquid may form a floating layer of water that reduces vapor emissions.

CONSEQUENCE

Addition of water will increase the volume of contained liquids.

MITIGATION

Contain spilled product and remove it as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

o-DICHLOROBENZENE
Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid o-dichlorobenzene may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Liquid o-dichlorobenzene may solidify under cold ambient temperature conditions and plug or clog transfer or storage equipment (unless they are specially designed for this possibility).

MITIGATION

Use equipment compatible with the spilled product. Do not apply this technique at temperatures below the melting point of the product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of afire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE.. . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. o-Dichlorobenzene, which is quite toxic to various varieties of fish and other aquatic life, is heavier than water and practically insoluble. It may be expected to sink to the bottom of a body of water and dissolve at a very slow rate.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

o-DICHLOROBENZENE
Division 6.1 (Poisonous Material)

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

CHEMICAL TREATMENT . . . Application of appropriate chemical agent(s) to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

January 1989

DICHLOROD IFLUOROMETHANE
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Dichlorodifluoromethane is a colorless usually odorless gas shipped as a liquid under pressure and used as an aerosol propellant, refrigerant, and solvent with additional uses in making foaming agents and plastics, detecting leaks, and freezing various materials. It is very slightly soluble in water and somewhat heavier. Its boiling point of about –21°F indicates that it will boil under virtually all ambient temperature conditions, thus evolving a large amount of vapor or gas that is heavier than air and may persist in pits, hollows, and depressions. The product is not flammable but containers may rupture violently in a fire due to increasing pressure. Liquid dichlorodifluoromethane weighs approximately 11.1 pounds per gallon.

Dichlorodifluoromethane is stable in normal transportation and does not react with water or other common materials. Mixtures with alkali or alkaline earth elemental metals, peroxides, or strong reducing agents may be explosive, however, and dichlorodifluoromethane reacts with a wide variety of other chemicals. The product is not corrosive to many common metals but these may act as catalysts for decomposition at high temperatures. Vapors in air are of low toxicity except at relatively high concentrations and the major hazard of direct contact with the liquid or concentrated vapors is frostbite. Decomposition in a fire situation may evolve highly toxic phosgene, fluorides, halogen acids, hyrogen chloride, and carbonyl halides.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 280 mg/1 (0.028%W) at 77°F (25°C)
Solubility in Other Chemicals: Soluble in most organic solvents, alcohol, and ether.
Specific Gravity (Liquid): 1.329 at 68°F (20°C)
Boiling Point: –20.6 to –21.6°F (–29.2 to –29.8°C) at 1 atm.
Melting Point: –247 to –252.4°F (–155 to –158°C)
Freezing Point: –251.9°F (–157.7°C)
Molecular Weight: 120.91
Heat of Combustion: Not pertinent
Vapor Pressure: 5 atm (73.5 psia) at 61°F (16.1°C)
Flash Point: Not flammable
Autoignition Temperature: Not pertinent
Burning Rate: Not pertinent
Stability: Stable
Corrosiveness: Will attack some plastics, rubber, and coatings. Usually stored in steel or aluminum but also noncorrosive to cast iron, lead, brass, copper, and tin.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with hot aluminum, mineral acids, amines, strong oxidizing or reducing agents, alkali and alkaline earth elemental metals and certain other chemically active metals, peroxides, caustics, nitrides, cyanides, mercaptans, organic sulfides, azo or diazo compounds, and hydrazines

IDENTIFICATION

Shipping Names: Dichlorodifluoromethane (USDOT and IMO)
Synonyms and Tradenames: Difluorodichloromethane; Arcton 6; Eskinion 12; F-12; Freon 12; Genetron 12; Isotron 12; fluorocarbon-12; refrigerant-12; halon 122 or 1220; propellant-12; halocarbon-12; Algofrene Type 2; FC-12; Electro-CF12; Freon F-12; Frigen 12; Isceon 12; Ledon 12; Ucon 12.
Chemical Formula: $CC1_2F_2$
Constituent Components(% each): 99.5% or more pure
49 STCC: 49 045 16
UN/NA Designation: UN1028
IMO Designation: 2.2, nonflammable gas
Physical State as Shipped: Liquefied compressed gas
Physical State as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless below 20% by volume.
Common Uses: Aerosol propellant; refrigerant; low-temperature solvent; leak-detecting agent; foaming agent; mfg. plastics; freezing or chilling of foods, cocktail glasses, and frozen tissue sections.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DICHLORODIFLUOROMETHANE
Division 2.2 (Nonflammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** Odorless below 20% by volume

Unusual Hazards: May evolve large amounts of vapors upon release to the environment. Vapors are heavier than air and may be harmful or cause asphyxiation if breathed in high concentrations. Such concentrations may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): 1250 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 1000 ppm over each 8 hours of a 40 hour work **week. (ACGIH)**

Conditions to Avoid: Open flames and high temperatures; incompatible materials; inhalation or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air. Direct contact may result in frostbite.

Hazards of Skin or Eye Contact: Contact with liquid dichlorodifluoromethane may cause frostbite indicated by pallor, redness, loss of sensation and swelling of affected tissue.

Hazards of Inhalation: Vapors are relatively non-toxic but may act as a narcotic and central nervous system depressant at high concentrations. Symptoms may include dizziness, difficulty in breathing, giddiness, disorientation, incoordination, nausea, vomiting, and possible cardiac arrhythmias or cardiac arrest. Asphyxiation may also occur. Epinephrine may sensitize the myocardium to this substance. A 5% concentration in air causes dizziness.

Hazards of Ingestion: Ingestion of significant amounts is unlikely in short-term exposures.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. Will generate large quantities of gas or vapor upon release which may help extinguish the fire.

Hazardous Combustion Products: May decompose to toxic phosgene, fluorides, halogen acids, hydrogen chloride, and carbonyl halides.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may rupture violently in fire due to overpressure. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with liquid dichlorodifluoromethane or cold vessels containing the product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious resistant clothing. Compatible materials may include neoprene and Viton among others.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 1000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1028

DICHLORODIFLUOROMETHANE
Division 2.2 (Nonflammable Gas)

FIRST AID

Nonspecific symptoms: Symptoms of narcosis or irregular heartbeat from inhalation of high vapor concentrations. Frostbite from direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with large amounts of water, occasionally lifting the eyelids. Remove all contaminated clothing. Flush affected body areas with water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing. Warning: Do not use hot water.

First Aid for Ingestion: Significant ingestion is unlikely in short-term exposures.

FIRE RESPONSE

Extinguishing Materials: Use suitable agent for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the cylinder may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire-exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Avoid contact with spilled product. Keep unprotected personnel upwind of spill area. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that dichlorodifluoromethane is highly volatile. Accumulations of heavy gas may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Dichlorodifluoromethane may not generate hazardous concentrations in air in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product has evaporated, particularly if the spill is small.

CONSEQUENCE

Hazardous levels of dichlorodifluoromethane in air may be found in the local spill area and immediately downwind under appropriate conditions.

MITIGATION

Restrict access of unprotected personnel from the local spill area and areas immediately downwind of spill area.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Dichlorodifluoromethane spills may expose downwind areas to toxic concentrations, particularly if large amounts are released.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

DICHLORODIFLUOROMETHANE
Division 2.2 (Nonflammable Gas)

TECHNIQUE

WATER FOG OR SPRAY ... . Water fog or spray applied to dichlorodifluoromethane vapors or fumes from a point downwind of the spill may accelerate their dispersal in the atmosphere. Try not to get water on liquid pools as this may accelerate vapor evolution.

CONSEQUENCE

Water runoff may contain a very small amount of dichlorodifluoromethane from contact with airborne vapors or fumes.

MITIGATION

Where important water sources are threatened, contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is some uncertain possibility that firefighting foam applied to the surface of quiescent liquid pools may slow the release of dichlorodifluoromethane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. It is possible that vapor evolution will increase during initial stages of foam application. The response may be ineffective.

MITIGATION

Proceed with caution. Consult qualified experts. Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Dichlorodifluoromethane may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained dichlorodifluoromethane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in a few cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressure may be developed in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

DICHLORODIFLUOROMETHANE
Division 2.2 (Nonflammable Gas)

WATER SPILL

TECHNIQUE .

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: This and following responses may not be necessary except where critical water sources are impacted. Dichlorodifluoromethane is highly volatile and of low solubility in water.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 1992

DICHLOROMETHANE
Division 6.1 Poisonous Material)

GENERAL INFORMATION

Dichloromethane, also shipped with the name "methylene chloride", is a volatile, colorless liquid with a boiling point in the range of 103.6 to 105.8°F and an odor like ether or chloroform that can become unpleasant and irritating as concentrations increase in air. It is somewhat soluble in water and heavier, so can be expected to sink and dissolve at a slow yet appreciable rate. The product does not have a flash point when tested by standard methods but its vapors can nevertheless be flammable at elevated temperatures. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. Dichloromethane weighs approximately 11.1 pounds per gallon. Its vapors are heavier than air and may persist for a time in low areas.

Dichloromethane does not react with water or many other common materials and is stable in normal transportation. It is, however, violently or explosively reactive with strong oxidizing agents. Toxicity of the product is generally low to moderate in acute exposures but the material has several unusual toxicological characteristics that require special attention. Products of combustion or thermal decomposition may be more hazardous than dichloromethane itself via inhalation and may include carbon monoxide, hydrogen chloride, hydrochloric acid, some small amounts of highly toxic phosgene and possibly chlorine, and other toxic substances.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Somewhat soluble; 2.0, 1.38, or 1.32 g/100 g water at 68°F (20°C); reported values vary but first in list appears most likely to be accurate.

Solubility in Other Chemicals: Soluble in acetone, ethanol, ethyl ether, and many other organic solvents.

Specific Gravity (Liquid): 1.322 –1.336 at 68°F (20°C)

Boiling Point: 103.6 –105.8°F (39.8 –41°C) at 1 atm.

Melting Point: –142.6 to –139.0°F (– 97 to –95°C)

Freezing Point: See melting point

Molecular Weight: 84.933

Heat of Combustion: –1,445 cal/g as standard net heat of combustion

Vapor Pressure: Approx 200 mm Hg (3.866 psia) at 46.4°F (8°C); 350 mm Hg (6.765 psia) at 68°F (20°C); 500 mm Hg (9.664 psia) at 86°F (30°C).

Flash Point: None when measured by standard closedcup method. Has been found to be flammable when subjected to a sufficiently high level of ignition energy.

Autoignition Temperature: Reported values range from 1033 to 1224°F (556 to 662°C).

Burning Rate: Not available

Stability: Stable

Corrosiveness: Not corrosive to common metals such as iron, copper, etc., at normal temperatures. At high temperatures and in presence of water, the product can corrode iron, some stainless steels, copper, nickel, and certain other metals. One authority recommends stainless steel, Teflon, bronze, and steel for pump and hose construction materials and reports that Viton or cross-linked polyethylene may be used with caution. Some forms of plastics, rubber, and coatings may be attacked.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Generally reported to react violently or explosively with strong oxidizing agents, strong acids, or caustics. Reactivity with chemically active metals is ambiguous. Seek additional information from qualified experts on the interaction of dichloromethane with specific substances where necessary. Space does not permit a full discussion of all known incompatible materials.

IDENTIFICATION

Shipping Names: Dichloromethane; methylene chloride

Synonyms and Tradenames: DCM; freon 30; methane dichloride; methylene bichloride; and methylene dichloride.

Chemical Formula: CH_2Cl_2

Constituent Components (% each): One source reports the the product is available in grades of 99% to 99.99% purity.

49 STCC: 49 411 32; 49 217 35

UN/NA Designation: UN1593

IMO Designation: 6.1, poisonous material

Physical State As Shipped: Liquid

Physical State As Released: Liquid, boiling liquid, gas, or mixture of gas and aerosols (small liquid droplets) depending on nature and temperature of release.

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant, aromatic, sweet, penetrating; like ether or chloroform. Becomes unpleasant and irritating at higher concentrations.

Common Uses: Has numerous uses as a solvent, aerosol propellant, fumigant; used for making plastics and printed circuit boards; used for shrink-fitting synthetic rubber covers, dyeing of synthetic fibers, and in organic synthesis.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DICHLOROMETHANE
Division 6.1 Poisonous Material)

PG III can replace
the word poison

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: One authority reports odor detectable at 3 to 30 ppm; two others say 25 ppm or 50 ppm; another says 150 ppm; many give a value of 200 ppm or more. Odor reported as being sweetish above 300 ppm but becoming unpleasant for most people at about 1000 ppm. At 2300 ppm, the odor is strong and intensely irritating; dizziness may occur after a 5 minute exposure.

Unusual Hazards: Highly volatile liquid with heavier than air vapors that may persist in low areas. Inhalation of vapors may be more hazardous to certain population groups than others. Products of combustion or thermal decomposition may be more toxic via inhalation than dichloromethane itself.

Short Term Exposure Limit (STEL): 125 ppm for 15 minutes was proposed by OSHA and pending a final rulemaking as of June 1992.

Time Weighted Average (TWA) Limit: 50 ppm over each 8 hours of a 40 hour work week (ACGIH, 1991–92); 25 ppm TWA proposed by OSHA and pending final rule in June 1992. ACGIH denotes the substance as a suspected human carcinogen.

Conditions to Avoid: Contact of dichloromethane with high heat, fire, strong sparks, or hot surfaces; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentrations of dichloromethane vapor or gas that may be present in air at the spill site and over potentially considerable downwind distances. Direct contact and ingestion should also be avoided.

Hazards of Skin or Eye Contact: Vapors are irritating to the eyes at higher concentrations and may cause discomfort, lacrimation, and temporary blurring of vision. Contact of the eyes with liquid dichloromethane may result in pain, lacrimation, a burning sensation, moderate to severe irritation and inflammation of the eyelids and conjunctiva, and temporary corneal injury possibly requiring a week or two for recovery in severe cases. The severity of effects depends upon the amount of liquid which enters the eye; prompt flushing with water will reduce severity. Contact of liquid dichloromethane with the skin is reported to rapidly cause an intense burning sensation. Mild irritation and a dry, scaly, fissured dermatitis may result from repeated contact if the material is allowed to freely evaporate from the skin. Pain, inflammation and moderate to severe burns may be expected if the chemical is confined or sealed to the skin by gloves, shoes, or tight clothing. Some small amounts of liquid may be absorbed through the skin but the hazard via this route of exposure is reported as limited. Contact lenses should not be worn when working with this chemical.

Hazards of Inhalation: Vapors of dichloromethane are slightly irritating to the nose, throat, and upper respiratory tract. Inhalation may cause narcosis and central nervous system depression with symptoms variably including lightheadedness, headache, dizziness nausea, vomiting, tingling or numbness in hands and feet fatigue, inability to concentrate, sense of fullness in the head, sense of heat, giddiness, stupor, confusion, irritability, dullness, incoordination, chills, lethargy, and drunkenness. Exposure to very high concentrations in air may result in rapid loss of consciousness and death but prompt removal from exposure prior to death is reported to usually result in complete recovery.

Hazards of Ingestion: Dichloromethane is considered to be of low to moderate toxicity in single oral doses. Ingestion may cause irritation of the gastrointestinal tract, vomiting, and various symptoms of inhalation. The lowest dosage reported to cause a human death is 0.36 g/kg of body weight but the accuracy of this estimate is unknown.

FIRE HAZARDS

Lower Flammable Limit: Reported values in air are usually 12% and 13% with the lower figure quoted most often. Ignition in air is difficult except at elevated temperatures (at or above about 212°F) or when vapors in the flammable range are subjected to a sufficiently high level of ignition energy.

Upper Flammable Limit: Reported values range from 18% to 23% in air but the upper limit quoted most often is 19% in air.

Behavior in Fire: *Will* generate large quantities of vapors upon release:' Vapors are heavier than air. Containers may rupture violently in fires.

Hazardous Combustion Products: Contact of dichloromethane with hot surfaces or an open flame may result in evolution of irritating and highly toxic substances including but not limited to carbon monoxide, hydrogen chloride, hydrochloric acid, and some small amounts of phosgene and possibly chlorine.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors within the flammable range encounter a suitable high energy source of ignition or are at elevated temperatures. Containers may rupture violently in fire. Contact with a variety of other chemicals may result in an explosion or formation of explosive substances.

1593

DICHLOROMETHANE
Division 6.1 Poisonous Material)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with dense fumes or smoke generated from burning or thermally decomposing quantities of dichloromethane and possibly in other cases where very high concentrations may be encountered in air. Compatible materials may include Viton/neoprene and Silvershield according to one highly respected authority. Another suggests that polyvinyl alcohol or a combination of polyethylene and ethylene vinyl alcohol may be appropriate.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, or skin; lightheadedness, headache, dizziness, nausea, giddiness, confusion, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. It may not be prudent to administer adrenalin (i.e., epinephrine) to severely exposed individuals since this may possibly result in cardiac sensitization (based on the results of animal studies). See "Hazards of Inhalation".

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water if product has not already evaporated. Get medical attention immediately if irritation persists after washing. Do not reuse contaminated items of leather clothing unless they can be fully decontaminated.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs and then repeat administration of water. (Note: Although a few sources of data suggest that vomiting be induced, most do not. NIOSH recommends that medical attention be obtained immediately, that vomiting be induced only if immediate medical attention is not available, and that no attempt be made to make an unconscious person vomit.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire if methylene chloride is not ignited. Water spray, dry chemical, carbon dioxide, or foam otherwise. Authorities disagree as to whether regular or alcohol foam should be used; both may be effective to some degree.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with dense fumes or smoke resulting from burning or decomposing dichloromethane may be encountered. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Although dichloromethane is considered difficult to ignite, it is prudent to assume that ignition is a possibility. Take the highly volatile nature of the substance and its heavier than air vapors into account when planning the response.

DICHLOROMETHANE
Division 6.1 Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Note that inhalation of dichloromethane vapors may be more hazardous to certain population groups than others.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to airborne dichloromethane may absorb and/or accelerate dispersal of its vapors.

CONSEQUENCE

Water runoff may contain varying amounts of dichloromethane from contact with its vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume arid overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of dichloromethane vapors into the atmosphere. (Note: Authorities disagree as to whether regular or alcohol type foams are best suited for use with this product; both may be effective to some degree.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . Dichloromethane is heavier than water and only somewhat soluble. Gentle application of alight spray of water onto the surface of confined pools of the liquid may form a floating layer of water that reduces vapor emissions.

CONSEQUENCE

Addition of water will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid dichloromethane or contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination. Migration of this product from ground spills to groundwater has been observed at hazardous waste sites.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

DICHLOROMETHANE
Division 6.1 Poisonous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities. These substances (with the exception of cement powder) are also suitable for absorbing contaminated runoff.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders scrapers, loaders, bulldozers or draglines. Note that final residues of dichloromethane are likely to evaporate fairly rapidly from exposed surfaces.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may possibly be ignited by motorized removal equipment under appropriate circumstances.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Dichloromethane is designated as a priority toxic pollutant and potential carcinogen by the EPA. It is heavier than water and somewhat soluble, so may be expected to sink in water and then dissolve at a slow yet appreciable rate.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination where possible and deemed appropriate.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts. Containment of material on bottom may not serve a useful purpose if the amount of water and the currents present therein are such that most or all of the dichloromethane will dissolve before recovery operations can be initiated.

MITIGATION

Excavate as last resort. Consult qualified experts on the advisability of this and the following related response technique under the spill conditions being encountered.

DICHLOROMETHANE
Division 6.1 Poisonous Material)

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air. A delay in implementation of this technique may permit all or most of the dichloromethane to dissolve in the water.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed .by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

DICHLOROPROPENE*
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Dichloropropene is a clear, straw colored liquid with a sharp, sweet, chloroform-like odor. It is slightly heavier than water and its vapors are heavier than air. Dichloropropene is toxic by all exposure routes and is flammable under most conditions. The low vapor pressure and relatively high boiling point suggest vapor generation will be relatively low and of greatest concern in the vicinity of the spill. Factors such as increasing the spill surface area or liquid temperature will increase vapor generation. Vapors will concentrate in low lying areas and, if concentration is sufficient, may represent a potential for ignition and flashback to source, particularly in confined settings. Vapors may accumulate in confined areas such as buildings or sewers and may present an explosion hazard.

Dichloropropene is normally stable and not subject to violent polymerization. It will react violently, as do most organic materials, in the presence of strong oxidizers. It is corrosive to aluminum, magnesium, zinc, and cadmium. It is incompatible with strong bases.

Dichloropropene is most commonly used in soil fumigant mixtures for control of soil nematodes. Mixtures may range from 95% dichloropropene preparations to mixtures of dichloropropene and dichloropropane (DD soil fumigant) or preparations containing other materials, such as chloropicrin. Dichloropropene exposures may produce skin sensitization in exposed persons. Dichloropropene is considered to be a potential carcinogen.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very low solubility, approximately 0.1%.

Solubility in Other Chemicals: Soluble in acetone, toluene, and octane.

Specific Gravity (Liquid): 1.220 @ 25°C (77°F)

Vapor Density (Air=1): 3.38

Boiling Point: 104 - 112eC (219.2 to 233.6°F)

Melting Point: -84°C (-119.2°F)

Freezing Point: -84°C (-119.2eF)

Molecular Weight: 110.98

Heat of Combustion: -3900 cal/gm

Vapor Pressure: 28 mmHg @ 25°C (77°F)

Flash Point: 35.°C (95°F) OC; 26°C (79'F) CC

Autoignition Temperature: Unavailable.

Burning Rate: 3.4 mm/min

Stability: Normally stable, not subject to violent polymerization reactions.

Corrosiveness: Corrosive to aluminum, magnesium, zinc, cadmium.

Reactivity with Water: Not reactive with water.

Reactivity with Other Chemicals: Corrosive to aluminum, magnesium, zinc, and cadmium. Incompatible with strong bases and strong oxidizers.

IDENTIFICATION

Shipping Names: Dichloropropene.

Synonyms and Tradenames: 1,3-dichloropropene; 1propene; 1,3-dichloro-Bis (2-chlorethyl) ether; á,ã-dichloropropylene; ã-chlorallyl chloride; vidden d; telone; telone II; CAS 542-75-6.

Chemical Formula: $CHC1{:}CHCH_2Cl$

Constituent Components (% each): Mixture of two isomers, Cis - and Trans-.

UN/NA Designation: UN2047

IMO Designation: 3.3, flammable liquid.

Physical State as Shipped: Liquid.

Physical State as Released: Liquid.

Color of the Shipped Material: Colorless, to light straw color.

Odor Characteristics: Odor of chloroform, sweet, pungent, and irritating.

Common Uses: Soil fumigant, organic synthesis.

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*Reportable Quantity (RQ) established. Refer to appendix I.

DICHLOROPROPENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1 - 3 ppm (5 - 15 mg/m^3).

Unusual Hazards: Moderate fire hazard. Toxic by inhalation, ingestion, and absorption. May produce skin sensitization in exposed persons.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): 1 ppm skin (5 mg/m^3) OSHA PEL - TWA

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Primary health hazards are associated with direct skin contact. Skin sensitization may occur in exposed individuals. Dichloropropene is toxic by all exposure routes and is considered to be a potential carcinogen.

Hazards of Skin and Eye Contact: Exposure to eyes may result in severe irritation and corneal injury. Vapors may be irritating to eyes and produce lachrymation (tearing). Dichloropropene is toxic by skin absorption on prolonged contact. It is irritating and a potential skin sensitizer.

Hazards of Inhalation: Strong irritant to respiratory mucous membranes. Prolonged exposure to excessive vapors may result in varying degrees of respiratory impairment including burning sensation, coughing, wheezing, shortness of breath, nausea and vomiting.

Hazards of Ingestion: Moderately toxic by ingestion. Likely to result in severe gastrointestinal distress. Animal data suggest target organs of toxicity include the liver and kidneys.

FIRE HAZARDS

Lower Flammable Limit: 5.3%.

Upper Flammable Limit: 14.5 %.

Behavior in Fire: Smoke may contain toxic and irritating vapors. Vapors are heavier than air and will tend to collect in confined spaces or low lying areas. Vapor concentrations may present a source for ignition and flashback to the source under circumstances favoring vapor buildup.

Hazardous Combustion Products: Toxic, irritating, likely to include unburned dichloropropene. Chemical formula suggests that products may include the formation of hydrogen chloride, and oxides of carbon.

EXPLOSION HAZARDS

Explosiveness: Ignition of vapors in confined settings may proceed at an explosive rate. Generally stable and not subject to violent polymerization.

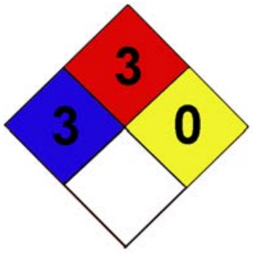
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with dichloropropene liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully encapsulating suits made of compatible material are appropriate for most large spill situations. Data is limited, however, butyl, neoprene, and nitrile rubber compositions have been suggested as suitable materials of construction..

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

2047

DICHLOROPROPENE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or bums to skin, eyes and respiratory tract. Severe gastrointestinal distress in cases involving accidental ingestion.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure resulting in increased respiratory distress with time. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Plush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists.

First Aid for Ingestion: Do not induce vomiting. Provide supportive care and seek medical assistance immediately. The risk of systemic toxicity is high when contaminant is aspirated into lungs. The decision to empty the stomach contents should be made by a physician considering the relative risks from toxicity and the danger from aspiration. There is no specific antidote for dichloropropene.

FIRE RESPONSE

Extinguishing Materials: Water fog, foam, alcohol foam, carbon dioxide, dry chemical.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with dichloropropene. Wear self contained breathing apparatus and appropriate personal protective clothing. Move intact container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. Avoid taking positions along container ends. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam or the application of water fog is appropriate for fires involving dichloropropene.

SPILL RESPONSES

General Information: Dichloropropene is flammable and toxic. Response strategies should account for the fact that flammable vapors are heavier than air and may collect locally in enclosed spaces or low lying areas. When spilled in water, dichloropropene is only slightly soluble and will tend to settle to the bottom of the water column, depending on velocity of water flow. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of dichloropropene may result in explosion.

DICHLOROPROPENE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION... Dichloropropene may not evolve large amounts of hazardous airborne contaminants in many outdoor situations. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of dichloropropene vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

MITIGATION

Remove spilled dichloropropene as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for dichloropropene vapor concentration.

TECHNIQUE

WATER FOG OR SPRAY... Water fog applied to dichloropropene vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain a small amount (if any) of dichloropropene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM... Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of dichloropropene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with dichloropropene.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Spills of dichloropropene liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Dichloropropene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater, which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

DICHLOROPROPENE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking dichloropropene.

CONSEQUENCE

Dichloropropene may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater, which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION... Accumulated dichloropropene pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Avoid equipment containing components made of materials such as aluminum, magnesium, zinc, and cadmium. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION... Spilled dichloropropene can be absorbed and immobilized with inert materials such as sand, earth, saw dust, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with dichloropropene and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL... Soil contaminated with dichloropropene may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Avoid equipment containing components made of materials such as aluminum, magnesium, zinc, and cadmium. Store contaminated materials in a safe and secure location.

DICHLOROPROPENE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE... Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION... Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

CONTAINMENT... Spilled dichloropropene is slightly denser than water and will tend to sink to the bottom, depending on the velocity of the water body. Use natural deep water pockets, excavated lagoons, or barriers to trap material on the bottom and limit spread of contamination.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Excavations are difficult and are not 100% effective.

MITIGATION

Monitor downstream users and test for signs of contamination. Take steps to remove trapped pockets of dichloropropene as soon as possible.

TECHNIQUE

DREDGING/PUMPING... Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic or flammable vapors.

MITIGATION

Consult qualified experts. Decontaminate equipment after use. Arrange to store and dispose of recovered materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

GENERAL INFORMATION

Dichlorosilane is a highly flammable, corrosive, and toxic gas. It is usually shipped in the United States as a liquefied compressed gas in relatively low pressure cylinders having a water capacity of 250 pounds or less. Under USDOT exemption, it may also be transported at times in larger portable containers. Some of these containers may not be equipped with safety pressure reief devices. The odor of the product has been reported to be irritating, acidic, suffocating, and repulsive. The substance is used in industry for making electronic devices.

Dichlorosilane gas rapidly reacts with water or moisture to form hydrogen chloride, hydrochloric acid, and various silicon-containing substances. The dry gas is colorless but significant leaks may result in the formation of dense white fumes of corrosive hydrogen chloride and hydrochloric acid upon contact with moist air as the gas vents under pressure from its container. Liquid dichlorosilane is heavier than water, and based on the properties of similar substances, may possibly react violently in contact with water or moisture. The liquid has a boiling point of approximately 47°F and will therefore fume, rapidly vaporize, and/or boil under a wide range of environmental conditions, producing large amounts of vapors and fumes if released into the environment [Note: Hydrochloric acid and hydrogen chloride each have reportable quantities* of 5000 lb (2270 kg). Hydrogen chloride gas is designated as an Extremely Hazardous Substance (EHS) by the EPA.]

A flash point of –35°F indicates that dichlorosilane is easily ignited under all ambient environmental conditions. An autoignition temperature variably reported to be 136°F or 212°F indicates that comparatively low temperatures are sufficient to cause the product to self-ignite or reignite. Indeed, the heat evolved by reactions with water may be sufficient to ignite the product according to at least one source of information. Dichlorosilane has an unusually wide range of flammable limits, these being 4.1% to 98.8% by volume in air.

Dichlorosilane gas and vapor are heavier than air, may travel a considerable distance to a source of ignition and flashback, and/or may accumulate and persist in pits, hollows, and depressions. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupure violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. An unusual hazard is that temperatures in excess of 125°F may cause a cylinder filled to its "normal" capacity to become full of liquid, potentially resulting in excessive pressure buildup and rupture of the container. Other unusual characteristics and hazards of the dichlorosilane are reported below. The product weighs approximately 10.5 pounds per gallon at its boiling point temperature.

Dichlorosilane is stable in normal transportation when in sealed containers. In the absence of moisture or water, dichlorosilane can be safely handled in mild steel equipment. If even small traces of water are present, however, the product becomes extremely corrosive due to the formation of hydrochloric acid. Hydrochloric acid corrodes most metals, particularly iron and aluminum, while evolving potentially flammable hydrogen gas which may explode if ignited in confinement. Very little specific information exists concerning reactivity of dichlorosilane with other materials.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if dichlorosilane is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts rapidly and possibly violently
Solubility in Other Chemicals: Not available
Specific Gravity (Liquid): Approx 1.26 at boiling point *Boiling Point:* 46.8–47.1°F (8.2–8.4°C) at 1 atm.
Melting Point: –187.6°F (–122.0°C) *Freezing Point:* See melting point
Molecular Weight: 101.01
Heat of Combustion: Not available
Vapor Pressure: Approx 1255 mm Hg (24.2 psia; 1.65 atm) at 68°F (20°C)
Flash Point: –35°F (–37.2°C), closed or open cup
Autoignition Temperature: One major authority reports that the measured autoignition temperature of dichlorosilane is above 212°F (100°C) but any accumulated monochlorosilane above the bulk liquid may reduce the autoignition temperature to about 136.4°F (58°C). Data sources report either this latter temperature or 212°F (100°C).
Burning Rate: Not available
Stability: Stable in normal transportation when in sealed container
Corrosiveness: In the absence of moisture or water, dichlorosilane can be safely handled in mild steel equipment.
Reactivity with Water: Based on the properties of similar materials, there is a possibility that the reaction of liquid dichlorosilane with water may be vigorous or violent. Products of the reaction include hydrogen chloride. The reaction generates heat and this heat may be sufficient at times to ignite the product.
Reactivity with Other Chemicals: Very little specific information exists for dichlorosilane. One maker simply reports that the product is incompatible with oxidizing materials or agents. Another adds alkalies, alcohols, and acetone to the list. The very similar substance known as trichlorosilane is reported to react violently or explosively with ammonia, alcohols, ketones, amines and alkanes but not with chlorinated hydrocarbons.

IDENTIFICATION

Shipping Names: Dichlorosilane (IMO); usually shipped as "poisonous gas, flammable, n.o.s." under USDOT regulations. A description such as "flammable liquid, corrosive, n.o.s." may also be acceptable according to one authority. Note that the USDOT requires that the specific chemical name of the product appear in shipping papers when n.o.s. designations are used.
Synonyms and Tradenames: Dichlorosilicane
Chemical Formula: $Si\text{-}H_2\text{-}Cl_2$
Constituent Components (% each): Usually transported and used in ultra high-purity grades for use in the electronics industry; typically at least 99.9% or more pure.
49 STCC: 49 201 76
UN/NA Designation: UN2189 (dichlorosilane)
IMO Designation: 2.3, poison gas
Physical State As Shipped: Liquid or compressed liquefied gas
Physical State As Released: Fuming and/or boiling liquid, gas, or mixture of gas and aerosols (small liquid droplets); the boiling point of the product is about 47°F.
Color of the Shipped Material: Large leaks of dichlorosilane are reported to form dense white fumes of hydrogen chloride and hydrochloric acid upon contact with moist air.
Odor Characteristics: Irritating, acidic, suffocating, repulsive
Common Uses: Used in industry for making electronic devices

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available for dichlorosilane; 1 to 5 ppm for hydrogen chloride or hydrochloric acid.

Unusual Hazards: Temperatures in excess of 125°F may cause a cylinder to become full of liquid, potentially resulting in excessive pressure buildup and rupture of the container. The autoignition temperature of dichlorosilane is reported to be unusually low by several authorities, indicating that the product may be easily ignited or reignited by relatively low temperature heat sources. Indeed, the heat produced by contact of liquid dichlorosilane with water may be sufficient to ignite the product. Dichlorosilane is flammable in air over a very wide range of concentrations. There is at least one report of spontaneous ignition of the product under ambient conditions. Vapors and fumes are heavier than air and may persist in low areas. Acidic decomposition products formed by burning dichlorosilane may rapidly attack the metal at the leak area, especially if the metal is hot. Spraying water on the source of any leak may also potentially cause corrosion due to formation of hydrochloric acid and increase the leakage area. Contact of hydrochloric acid with metals may result in the generation of hydrogen gas.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Ceiling (C) Limit: Not established for dichlorosilane; 5 ppm absolute ceiling limit for hydrogen chloride (ACGIH, 1990–91; OSHA, 1989)

Conditions to Avoid: Heat fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Dichlorosilane is irritating and corrosive to all living tissue. Major hazard is from exposure to high vapor or fume concentrations that may exist in air in the spill area and over significant distances downwind. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid dichlorosilane or its concentrated vapors or fumes may rapidly result in severe inflammation (with redness and possible swelling) or highly painful acid burns and skin lesions resulting in early necrosis (death of tissue) and scarring. Prolonged or widespread skin contact with the liquid may result in the absorption of potentially harmful amounts. Contact of the eyes with vapors or fumes may cause severe irritation causing pain, excess lachrymation, closure of the eyelids, and marked excess redness and swelling of the conjunctiva. High concentrations of the gas or vapor in air or contact with the liquid may cause severe corneal burns and injury that may result in permanent damage with possible loss of sight. Do not wear contact lenses when working with this substance. (Note: According to one major authority, irritation of the eyes may not be felt or observed immediately after the exposure. In some cases, symptoms of eye exposure may be delayed several hours. Prompt treatment by a physician may be required even if no signs of irritation or injury are evident directly after the exposure.)

Hazards of Inhalation: Gases, vapors, or fumes resulting from discharges of dichlorosilane may cause irritation of the respiratory tract with burning, choking, coughing, excess sputum and saliva formation, and chest discomfort. Higher levels in air may result in burns and ulceration of the nose and throat, laryngeal edema or spasm, labored breathing, pulmonary edema, pneumonitis, and possibly death. The onset of pulmonary edema and pneumonitis may be delayed. Some individuals who survive the exposure may experience permanent injury. Although recent data indicate higher levels may be tolerable for a short time, authorities have traditionally warned that concentrations of 1000 to 2000 ppm of hydrogen chloride or hydrochloric acid in air may be dangerous to humans in even brief exposures.

Hazards of Ingestion: Ingestion of liquid dichlorosilane or concentrated acid may be expected to result in burns of the mouth, throat and stomach, pain, nausea, vomiting, and possibly death due to esophageal or gastric necrosis. Although not mentioned in the literature specifically with reference to ingestion, it should be noted that contact of liquid dichlorosilane with water may result in its ignition according to various authorities.

FIRE HAZARDS

Lower Flammable Limit: 4.1%

Upper Flammable Limit: 98.8%

Behavior in Fire: Containers may rupture violently in fire and possibly rocket. Some containers may not be equipped with safety pressure relief devices and will be particularly at risk. Temperatures in excess of 125°F may cause a cylinder to become full of liquid, potentially resulting in pressure buildup and container rupture. Due to its reported low autoignition temperature, dichlorosilane may be easily ignited, or reignited upon extinguishment (possibly explosively), by relatively low temperature heat sources. Contact with water used for firefighting may cause unignited dichlorosilane to ignite. Acidic decomposition products formed by burning dichlorosilane from leaks may rapidly attack the metal at the leak area, especially if the metal is hot. Spraying water on the source of any leak may potentially cause corrosion due to formation of hydrochloric acid and increase the leakage area. The product will generate potentially large quantities of flammable and corrosive vapors and fumes upon release.

Hazardous Combustion Products: Decomposition products are reported to include hydrogen chloride, hydrochloric acid, chlorine, and finely divided amorphous silica.

2198

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire and possibly rocket. Some containers may not be equipped with safety pressure relief devices and will be particularly at risk of rupture upon heating. Temperatures in excess of 125°F may cause a cylinder to become full of liquid, potentially resulting in pressure buildup and rupture of the container. If flames are extinguished, there is an unusual risk of reignition, which may be explosive in nature. Contact of hydrochloric acid with most metals produces hydrogen gas that may explode if ignited in a confined space.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with dichlorosilane or its acidic reaction products with water. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing for normal working conditions. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor, fume, or smoke concentrations in air. Various makers of dichlorosilane indicate that neoprene, natural rubber, polyvinyl chloride, or polyethylene may be compatible materials. The only material that appears to be simultaneously resistant to dichlorosilane, fairly concentrated hydrogen chloride or hydrochloric acid, and chlorine with some confidence is neoprene. Other materials that may provide adequate protection for a time appear to include Viton and Saranex. In the absence of fire, in which case chlorine will not be present in air as a product of combustion, possibilities appear to additionally include natural rubber and nitrile rubber. The issue is obviously complicated by the number of possible substances involved. It is very likely that several other materials would also be adequate for short-term emergency response purposes but insufficient data are available for a clear determination.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; choking, coughing or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Note that some symptoms may be delayed. Treatment by a physician may be necessary even if no symptoms of exposure are immediately evident. Keep victim under medical observation for at least 24 hours and possibly longer to detect early signs of pulmonary edema. Airway obstruction, as indicated by a harsh rasping breath sound from the larynx, may require the placement of an airway by qualified emergency medical technicians.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately, keeping in mind that the effects of eye exposure may be delayed. Proceed with caution where "dry" dichlorosilane has contaminated combustible clothing or the skin since contact with water may result in ignition of the dichlorosilane. Use drenching or flooding amounts of water where necessary.

First Aid for Ingestion: Specific first aid measures for ingestion of dichlorosilane were not found in the literature. For hydrochloric acid, it is suggested that large quantities of water be administered immediately if the victim is conscious, that no attempt be made to make the victim vomit, and that immediate medical attention be obtained. If vomiting occurs naturally, have the victim lean forward and keep head below hips to reduce the risk of aspiration of any liquids into the lungs.

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

FIRE RESPONSE

Extinguishing Materials: Shut off leak if no risk. Carbon dioxide or dry chemical are recommended for small fires. If reignition occurs or the fire cannot be extinguished, let it burn out while cooling containers unless the flow of dichlorosilane can be stopped safely. Use water spray or foam for larger fires. (Note: Authorities disagree and variously recommend regular foam, alcohol foam, or all-purpose foam for dichlorosilane fires. It is possible that all are effective to some degree.) Coarse water spray is recommended by one maker of the product because the reaction of dichlorosilane with water to form hydrochloric acid is said to be more rapid than the combustion reaction. Do not apply water to point of the leak in the container. Keep in mind that application of water to unignited liquid dichlorosilane may result in its ignition. Be prepared for this eventuality and take it into account while planning your fire response. Also remember that the autoignition temperature of the product is very low. Explosive reignition is possible.

Extinguishing Techniques: Unusual corrosive vapor/fume, reactivity, and flammability hazard. Stop leak if you can do it without risk. Stay upwind. Wear breathing apparatus and appropriate protective clothing, including fully-encapsulating vapor-protective suit where contact with material or dense fumes or smoke is anticipated. Move container from fire area if no risk. Let container burn unless leak can be stopped; with smaller tanks or cylinders, extinguish/isolate from other flammables. Be alert to the possibility that the container may rupture violently, possibly rocket, and suddenly release massive amounts of product when exposed to high heat. Stay away from ends of container involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out while recognizing hazards and warnings reported directly above. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill site and out of low areas. Avoid all contact with discharged product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Due to its reactivity with water, always handle dichlorosilane in dry equipment with a dry inert gas such as nitrogen. Pressurization with a dry inert gas is preferable to pumping for transfer purposes. Since reverse flow into a cylinder may cause rupture, use a check valve or other protective device in any line or piping from a cylinder to prevent reverse flow. Take the many unusual characteristics and hazards of dichlorosilane into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Dichlorosilane discharges may expose downwind areas to flammable and toxic concentrations over considerable distances in some cases. Dense white fumes of hydrogen chloride and hydrochloric acid are expected to form where there are large leaks of the product into moist air.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to dichlorosilane in air may react with, knockdown, and accelerate dispersal of vapors and fumes in the atmosphere. Apply water at a point downwind and do not let it contact pools of liquid dichlorosilane since this may cause ignition of the product, a violent reaction, and/or increased fume evolution rates. Do not apply water to the point of a leak in a container; any hydrochloric acid formed may cause corrosion and increase the area of the leak; the reaction with water may result in ignition of the dichlorosilane.

CONSEQUENCE

Water runoff may contain corrosive hydrochloric acid and other chemicals from contact with airborne vapors and fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid dichlorosilane may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller liquid spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Contact with inadequate amounts of water may lead to ignition and sustained combustion of the product. The sudden reaction with water may be violent.

MITIGATION

Some possibilities include downwind knockdown of vapors or fumes via water fog or spray and temporary evacuation of surrounding populations and other vulnerable resources. Proceed with caution and from a distance. Ensure that water can be applied in flooding quantities for a sustained period of time. Consult qualified experts for guidance where necessary.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid dichlorosilane or contaminated water runoff may be contained by building dikes using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of these liquids and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as appropriate and as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained liquids as appropriate and as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PRESSURIZED TRANSFER/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using vacuum trucks or another vacuum based system. Note that pressurization with a dry inert gas is preferable to use of pumps and hoses for transfer purposes between containers. Pumps and hoses should be used with great caution, if at all, and only if constructed of compatible materials and extremely dry and clean. Keep the potentially low autoignition temperature of the product in mind when using mechanical equipment with heat sources such as motors.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment. Heat and intake of even a small amount of air may lead to ignition or explosion of the product.

MITIGATION

Consult qualified experts for assistance. Use equipment of proper pressure capacity that is compatible with the spilled product and the hydrochloric acid that forms in contact with moisture or water. Avoid contact of the product with water or moist air. Avoid exposure of the product to heat. Consider using a dry cold gas such as nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of the product into equipment.

TECHNIQUE

ABSORPTION . . . Where temperatures permit, spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, fly ash, cement powder, compatible commercial sorbents and other compatible substances according to various authorities. Note that the boiling point of dichlorosilane is approximately 47°F and that the liquid product will boil or otherwise vaporize rapidly under most ambient temperature conditions. This technique is most appropriate in very cold weather and/or where sorbents can quickly and safely be placed in appropriately sealed, dry, and compatible containers.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under the guidance of a qualified expert. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

DICHLOROSILANE
Division 2.3 (Poisonous Gas)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product or acid runoff that has been contained to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical neutralization agents may entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and/or liquid residues may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Motorized equipment or other heat sources may easily ignite any flammable vapors in the spill area due to the low flash point and potentially low autoignition temperature of dichlorosilane.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product and any hydrochloric acid which forms in the presence of moisture or water. Store contaminated materials in a safe and secure location. Do not operate motorized equipment where their use may lead to ignition of the product. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Dichlorosilane is heavier than water and rapidly reacts with it to form hydrogen chloride, hydrochloric acid, and other substances variously reported to include silica, silicon oxyhydride, polymeric siloxanes, and/or insoluble silicon-containing solids or fluids. The reaction produces heat.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Contaminated water may be contained (or diverted to an impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards due to formation of acids.

CONSEQUENCE ,

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Where deemed necessary by environmental officials or other experts stream or lake beds may be dredged to remove heavier-than-water insoluble silicon-containing products of reaction with water and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for recovery.

CONSEQUENCE

Dredging may accelerate dispersal of contaminants through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Use equipment compatible with the materials expected to be recovered. Consult qualified experts for guidance.

July 1994

DICYCLOPENTADIENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Pure dicyclopentadiene is a colorless, crystalline solid, with a camphor like- odor. Solids will melt at around 32°C (89.6°F) to form a clear, colorless liquid. In commerce, however, it is typically found in the form of a mixture which is clear, colorless liquid consisting of from 60 -95% dicyclopentadiene and weighing approximately 8.2 pounds per gallon. This mixture is a flammable liquid and will have a camphor- like odor. The vapor pressure of pure dicyclopentadiene is low. This, coupled with a relatively high boiling point, indicates that vapor generation will be relatively low and of greatest concern in the immediate vicinity of the spill. Factors, such as increasing the spill surface area or liquid temperature, will increase vapor generation. Vapors are heavier than air and will tend to concentrate in low lying areas. If the vapor concentration is sufficient, ignition and flashback to source, particularly in confined settings, are possible. Vapor accumulations in confined areas, such as buildings or sewers, may present an explosion hazard. Dicyclopentadiene is somewhat lighter than water and is insoluble in water. Spills can be expected to float to the surface.

Dicyclopentadiene is widely used in the development of various polymer resins. It is a basic component in the manufacture of polyester resins used in a variety of commercial products. Non- reinforced polyester is used in insulators for electrical coils, fiber reinforced polyester is used in boating equipment, counter tops, molded shower stalls, and automotive parts. Dicyclopentadiene is also widely used in the manufacture of adhesives, sealants, and treatments for floor tiles and tires, flame retardants, and as a basic substrate for the manufacture of certain pesticide compositions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble.
Solubility in Other Chemicals: Soluble in alcohol, ether and acetic acid.
Specific Gravity (Liquid): 0.93 - 1.07
Vapor Density (Air= 1): 4.6
Boiling Point: 170°C (338°F), decomposes.
Melting Point: 32.5°C (90.5°F)
Freezing Point: 32.5°C (90.5°F)
Molecular Weight: 132.31
Heat of Combustion: - 10,400 cal/gm
Vapor Pressure: 36.5 mmHg @ 20°C (68°F)
Flash Point: 4.4 to 32.2°C (40 - 90°F)
Autoignition Temperature: 510°C (950°F)
Burning Rate: Unavailable.
Stability: Dicyclopentadiene is normally stable unless heated to near boiling point where it decomposes to cyclopentadiene. On heating or contact with acid polymerization catalysts (boron trichloride, aluminum trichloride), may polymerize violently.
Corrosiveness: Not corrosive, irritating to skin.
Reactivity with Water: Not reactive with water, insoluble, floats.
Reactivity with Other Chemicals: Reacts with oxidizers and may ignite, reacts with acids and polymerizes in the presence of catalysts such as boron trichloride or aluminum trichloride.

IDENTIFICATION

Shipping Names: Dicyclopentadiene
Synonyms and Tradenames: á-Dicyclopentadiene; CAS 77-73-6.
Chemical Formula: $C_{10}H_{12}$
Constituent Components (% each): 60 - 95 % dicyclopentadiene, codimers (15 - 23%), may contain small percentages of benzene, less than 1 %, and light ends (C_6 hydrocarbons or lower) less than 3%.
UN/NA Designation: UN2048
IMO Designation: 3.3, flammable liquid.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Colorless to light straw colored.
Odor Characteristics: Odor of camphor, unpleasant.
Common Uses: Manufacture of resins, synthetic alkaloids, and camphors; intermediate for insecticides. Used in manufacture of paints and varnishes, flame retardants for plastics.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424- 9300 OR (202) 483- 7616

DICYCLOPENTADIENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 0.02 ppm (1.098 mg/m^3)
Unusual Hazards: Flammable, moderate fire risk. On heating to near boiling, may violently polymerize.
Short Term Exposure Limits (STEL): Unavailable.
Time Weighted Average (TLV-TWA): 5 ppm (27.45 mg/m^3) air, OSHA PEL - TWA
Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Primary health hazards are associated with ingestion and inhalation. While absorption through intact skin is possible, it is unlikely that a single prolonged exposure will result in absorption of harmful amounts.
Hazards of Skin and Eye Contact: Will produce localized, transient irritation to the eyes. Not likely to cause permanent eye damage unless exposure is severe. Lengthy exposures to skin may produce irritation. Skin burns are unlikely unless exposure is prolonged and severe.
Hazards of Inhalation: May cause irritation to respiratory mucous membranes. Prolonged exposure to excessive vapors may result in headache, dizziness, and other anesthetic effects. Respiratory symptoms may include coughing, wheezing, shortness of breath.
Hazards of Ingestion: Dicyclopentadiene is moderately toxic by ingestion. Symptoms may include nausea and abdominal pain. Excessive exposures can result in systemic toxicity targeting the central nervous system, liver and kidneys.

FIRE HAZARDS

Lower Flammable Limit: 1 %
Upper Flammable Limit: 7 - 10%
Behavior in Fire: A moderate ignition risk. Vapor generation is likely to be localized in the vicinity of the spill. Vapors are heavier than air and may ignite and flashback to the source. Vapors may collect in low lying areas and enclosed buildings. Temperature and spill surface area will affect the generation of flammable vapors.
Hazardous Combustion Products: May contain unburned product, oxides of carbon (carbon dioxide, carbon monoxide).

EXPLOSION HAZARDS

Explosiveness: Vapors collected and ignited in confined spaces may present an explosion hazard. Violent polymerization is possible in containers exposed to fire. Threat is greatest when temperatures reach near the boiling point (170°C, 338°F).

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with dicyclopentadiene liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully covering or encapsulating suits, made of compatible material are appropriate for most large spill situations.
Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

2048

DICYCLOPENTADIENE
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific Symptoms: Irritation to eyes, localized and transient irritation to skin on prolonged exposure, abdominal distress on ingestion. Anesthetic effects including headache, dizziness on prolonged respiratory exposure accompanied by coughing or wheezing depending on exposure duration.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists.

First Aid for Ingestion: Do not induce vomiting. Provide supportive care and seek medical assistance immediately. The risk of systemic toxicity is high when contaminant is aspirated into lungs. The decision to empty the stomach contents should be made by a physician considering the relative risks from toxicity and the danger from aspiration.

FIRE RESPONSE

Extinguishing Materials: Water fog, foam, alcohol foam, carbon dioxide, dry chemical.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with dicyclopentadiene. Wear self contained breathing apparatus and appropriate personal protective clothing. Move intact container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam or the application of water fog is appropriate for fires involving dicyclopentadiene.

SPILL RESPONSES

General Information: Dicyclopentadiene is flammable and toxic. Response strategies should account for the fact that flammable vapors are heavier than air and may collect locally in enclosed spaces or low lying areas. When spilled in water, dicyclopentadiene is insoluble and will tend to float on the waters surface depending on the water flow velocity. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of dicyclopentadiene may result in explosion.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION... Dicyclopentadiene may not evolve large amounts of hazardous airborne contaminants in many outdoor situations. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of dicyclopentadiene vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

DICYCLOPENTADIENE
Class 3 (Flammable Liquid)

AIR SPILL (CONTINUED)

MITIGATION

Remove spilled dicyclopentadiene as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for dicyclopentadiene vapor concentration.

TECHNIQUE

WATER FOG OR SPRAY... Water fog applied to dicyclopentadiene vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain a small amount (if any) of dicyclopentadiene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM... Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of dicyclopentadiene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with dicyclopentadiene.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Spills of dicyclopentadiene liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Dicyclopentadiene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking dicyclopentadiene.

CONSEQUENCE

Dicyclopentadiene may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

LAND SPILL (CONTINUED)

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION... Accumulated dicyclopentadiene pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION... Spilled dicyclopentadiene can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbents.

CONSEQUENCE

Sorbents will become contaminated with dicyclopentadiene and will pose the same hazards as the spilled product. Use of sorbents will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbents to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL... Spilled dicyclopentadiene and contaminated soil may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE... Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

DICYCLOPENTADIENE
Class 3 (Flammable Liquid)

WATER SPILL (CONTINUED)

TECHNIQUE

FLOATING BOOMS/BARRIERS... Oil spill containment booms of compatible materials may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of the spilled dicyclopentadiene.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT/DIVERSION... Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

SURFACE SKIMMING... Oil spill skimming devices may be deployed to recover floating dicyclopentadiene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose a hazard to future users. Fire hazards pose risk to personnel and equipment.

MITIGATION

Decontaminate equipment after use. Store recovered dicyclopentadiene in a safe and secure location. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

ABSORPTION... Straw, hay, peat, or commercial sorbent materials compatible with dicyclopentadiene may be used to absorb spilled product form the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of the contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

March 1995

DIETHANOLAMINE

Class 9 (Miscellaneous Hazardous Material)

GENERAL INFORMATION

Diethanolamine is a colorless or faintly colored combustible substance that has a melting point of 82.4°F and may be shipped as a molten liquid or crystalline solid. It is used to make detergents, lubricants, and dispersing agents found in a wide variety of commercial products and is also used for making rubber and other chemicals. It is highly soluble in water and will mix freely and rapidly. Its flash point in excess of 300°F indicates that substantial preheating is necessary before the product can be ignited easily. Accumulations of vapor from only very hot liquid may explode if ignited in confined spaces such as buildings or sewers. The product weighs approximately 9.1 pounds per gallon as a liquid. Diethanolamine does not react with water or many other common materials and is stable in normal transportation. It is generally noncorrosive to metals with certain exceptions and is described as being incompatible with strong acids, strong oxidizing agents that may cause its ignition, and carbon dioxide. The product has a low vapor pressure and is primarily an irritant to bodily tissues upon direct contact. Products of combustion are toxic and may include oxides of nitrogen, ammonia, and carbon monoxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Highly soluble; 95.4 – 96% wt at 68°F (20°C)

Solubility in Other Chemicals: Soluble in methyl alcohol and acetone

Specific Gravity (Liquid): 1.092 at 86°F (30°C)

Boiling Point: 514 – 516°F (268 – 269°C) at 1 atm; may decompose

Melting Point: 82.4°F (28°C)

Freezing Point: See melting point

Molecular Weight: 105.14

Heat of Combustion: –6000 cal/g

Vapor Pressure: Less than 0.01 mm Hg (0.0002 psia) at 68°F (20°C)

Flash Point: 305 – 336°F (151.7 –168.9°C), closed cup; 306 –342°F (152.2–172.2°C), open cup; reported values vary.

Autoignition Temperature: 1224°F (662°C)

Burning Rate: 0.74 mm/minute

Stability: Stable

Corrosiveness: Generally noncorrosive; may use iron or mild steel. Water levels above 15% or temperatures above 140°F (60°C) will corrode aluminum and evolve hydrogen gas. Avoid copper.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Incompatible with strong acids, strong oxidizing agents, and carbon dioxide.

IDENTIFICATION

Shipping Names: Enviromentally Hazardous Substance, Solid, N.O.S.

Synonyms and Tradenames: 2,2’-Iminodiethanol; 2,2’-iminobisethanol; bis(2-hydroxyethyl) amine; di(2-hydroxyethyl) amine; 2,2’-dihydroxydiethylamine; diethylolamine; diolamine; B,B’-dihydroxyethylamine; 2,2’-aminodiethanol; DEA

Chemical Formula: $(HOCH_2CH_2)_2NH$

Constituent Components (% each): 98.5% or more pure unless shipped as water solution; may contain small amounts of mono- and triethanolamine and a trace of ethylene oxide.

UN/NA Designation: UN3077

IMO Designation: 9, Miscellaneous Dangerous Substance

Physical State As Shipped: Usually as hot viscous liquid

Physical State As Released: Hot liquid or solid (solidifies below 82.4°F when pure)

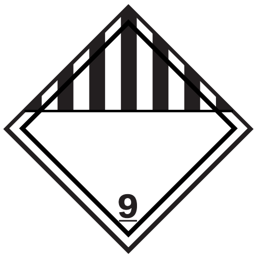
Color of the Shipped Material: Colorless or faintly colored crystals or liquid

Odor Characteristics: Mild ammonia or dead fish odor; pungent

Common Uses: Making liquid detergents and textile lubricants; intermediate for rubber chemicals; humectant and softening agent; dispersing agent; scrubbing agent for fuel gases; in organic synthesis.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

DIETHANOLAMINE
Class 9
(Miscellaneous Hazardous Material)



POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Ethanolamines can generally be detected at 2 – 3 ppm in air.

Unusual Hazards: None, but note that solid diethanolamine may absorb moisture from the air and liquefy.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 3 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: High heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Due to its very low vapor pressure, excessive outdoor inhalation exposures to this product are not likely unless individuals are very close to the spilled material, large quantities have spilled, and/or the product is very hot. Primary hazards are from direct physical contact and ingestion.

Hazards of Skin or Eye Contact: Brief contact of the skin with diethanolamine may cause smarting and local redness. Prolonged contact may result in severe irritation and possible burns. Prolonged contact with the eyes may cause moderate to severe irritation and corneal injury and burns. Brief contact followed by prompt washing with water is said to result in irritation and slight injury that heals rapidly.

Hazards of Inhalation: Vapors of diethanolamine may be irritating and may cause coughing and discomfort in the nose, throat, and chest. Excessive exposures may result in severe irritation of respiratory tract tissues, lung congestion, and possible injury to the lungs, liver, and kidneys.

Hazards of Ingestion: Diethanolamine is generally considered to be of low toxicity by ingestion. Nevertheless, one authority reports that intake of the concentrated product may cause burns of the mouth, throat, esophagus, and stomach with symptoms including pain or discomfort, nausea, vomiting, diarrhea, dizziness, drowsiness, faintness, weakness, collapse, and coma.

FIRE HAZARDS

Lower Flammable Limit (LFL): 1.6% (calculated)

Upper Flammable Limit (UFL): 9.8% (estimated)

Behavior in Fire: Combustible liquid or solid. Will burn but difficult to ignite.

Hazardous Combustion Products: May include toxic oxides of nitrogen, ammonia, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors of very hot liquid (above 300°F) are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant cothing. A manufacturer of diethanolamine lists compatible materials as including neoprene, Buna-N, and polyvinyl chloride (PVC). Various protective clothing manufacturers list numerous other typical materials as compatible to some degree. The known exceptions are Viton and styrenebutadiene rubber.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, under ordinary circumstances, a chemical cartridge respirator with a full facepiece that provides protection against diethanolamine as needed within the use limitations of these devices.

3077

DIETHANOLAMINE
Class 9 (Miscellaneous Hazardous Material)

FIRST AID

Nonspecific Symptoms: Irritation of the skin, eyes, respiratory tract, or other bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing. Destroy any contaminated leather clothing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Although several authorities recommend inducement of vomiting, at least one recommends against the practice. Seek immediate medical advice on this issue if possible.)

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, alcohol foam. Water may be used to dilute spill to nonflammable mixture but do not use solid stream of water (or foam) on hot burning pools as this may cause frothing and increase fire intensity. Note that one authority states carbon dioxide is incompatible with this product but most recommend its use on fires. Use carbon dioxide with caution at first.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment under appropriate circumstances. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Diethanolamine will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of diethanolamine in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to diethanolamine vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of diethanolamine from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

DIETHANOLAMINE
Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of diethanolamine vapors into the atmosphere. The fact that alcohol foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to spilled diethanolamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid diethanolamine may be contained by building dikes using soil, sand or other materials. Note and take into account that the product will solidify at temperatures below 82.2°F (28°C) when pure.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Solidification of pure product may clog lines or pumps.

MITIGATION

Use equipment compatible with the spilled product. Heat transfer system where necessary or use alternative removal procedure.

DIETHANOLAMINE

Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

DIETHANOLAMINE
Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture some part of the spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Carbon treatment is of low to moderate effectiveness.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

October 1993

DIETHYLAMINE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Diethylamine is a colorless, flammable, and quite volatile liquid with a fishy, musty, sharp odor resembling ammonia. The substance is fully soluble in water and will mix freely. It may boil when released from containers exposed to very high ambient temperatures or when heated somewhat. It can easily be ignited under virtually all ambient temperature conditions. Vapors of the substance are heavier than air, may accumulate and persist in low areas, or may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. The liquid weighs approximately 5.9 pounds per gallon.

It does not react with water or many other common materials and is stable in normal transportation. It can be corrosive to a variety of metals, however, and may attack many forms of plastics, rubber, and coatings. Additionally, it is reactive with numerous other chemicals, including strong oxidizing agents and strong acids. The substance and its vapors are highly corrosive to bodily tissues and their toxic hazard must be considered high by all possible routes of exposure. Products of combustion are reported to include toxic and/or irritating gases such as ammonia, carbon monoxide, carbon dioxide, various hydrocarbons, various amines, and very highly toxic oxides of nitrogen.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if diethylamine is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble.

Solubility in Other Chemicals: Soluble in acetone, dimethyl sulfoxide, benzine, ether, ethyl alcohol, and various other organic solvents.

Specific Gravity (Liquid): 0.71 - 0.74 at 68°F (20°C).

Boiling Point: 131.0 - 134.6°F (55 - 57°C) at 1 atm.

Melting Point: - 58 to - 54.4°F (- 50 to -48°C).

Freezing Point: See melting point.

Molecular Weight: 73.14.

Heat of Combustion: - 9,994 cal/g.

Vapor Pressure: 189 - 200 mm Hg (3.653 - 3.866 psia) at 68°F (20°C); 400 mm Hg (7.732 psia) at 100°F (37.8°C).

Flash Point: -24°F to 0°F (- 31.1 to - 17.8°C), closed-cup; - 24°F (- 31.1°C) to 5°F (- 15°C), open-cup.

Autoignition Temperature: 594°F (312°C).

Burning Rate: 6.7 mm/minute.

Stability: Stable.

Corrosiveness: Limited data for diethylamine indicate that aluminum, copper, and zinc and their alloys (as well as zinc galvanized surfaces) should be avoided. The substance will attack many forms of plastics, rubber, and coatings. Steel and stainless steel are reported as compatible. Data for very similar ethylamine indicate that iron, steel, stainless steel, steel reinforced neoprene lines, and lead or asbestos composition gaskets are compatible. Aluminum, copper, lead, silver, tin, zinc, many of their alloys, and possibly nickel, are reported to be corroded by moist ethylamine.

Reactivity with Water: No reaction. Generates some heat while dissolving in water to form a strongly alkaline solution.

Reactivity with Other Chemicals: Diethylamine is said to react violently with considerable heat evolution in contact with sulfuric acid; contact with cellulose nitrate of high surface area may lead to spontaneous ignition; contact with strong oxidizers may cause fires and explosions; contact with strong acids may cause spattering; a mixture with 4-chloroacetophenone may explode when heated; the material is specifically reported as incompatible with chlorine, halogenated compounds, hypochlorites, nitrous acid, nitrites, reactive organic compounds, and some metals. The reaction of diethylamine with nitrites or other nitrosating agents can form potent carcinogens. Similar amines explode in contact with mercury. Aliphatic amines such as diethylamine generally evolve heat in reactions with aldehydes, non-oxidizing mineral acids, or organic acids; generate heat and toxic gases in reactions with oxidizing mineral acids, halogenated organics, or organic peroxides or hydroperoxides; evolve heat and flammable gases in reactions with alkali or alkaline earth elemental metals or strong reducing agents; generate heat, toxic gases, and fire in reactions with strong oxidizing agents; generate heat and cause violent polymerization of epoxides or isocyanates; and may possibly react in a hazardous fashion with dithiocarbamates.

IDENTIFICATION

Shipping Names: Diethylamine.

Synonyms and Tradenames: 2-Aminopentane; DEA; DEN; DETN; diethamine; n,n-diethylamine; and n-ethylethanamine.

Chemical Formula: $(CH_3CH_2)_2NH$.

Constituent Components (% each): 99% or more pure or as a solution in water.

UN/NA Designation: UN1154.

IMO Designation: 3, flammable. Physical State As Shipped: Liquid.

Physical State As Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Fishy, musty, sharp, like ammonia.

Common Uses: Making rubber and textile chemicals, corrosion inhibitors, dyes, flotation agents, resins, pesticides, pharmaceuticals, polymerization inhibitors, petroleum chemicals, polymers, surfactants, and electroplating solutions; used as selective solvent and as depilatory for animal skins.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

DIETHYLAMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at very low concentrations in air; reported odor thresholds are 0.14 and 0.3 ppm. Similar amines fatigue the sense of smell with time such that odor may not remain a reliable warning property.

Unusual Hazards: Contact with nitrites or other nitrosating agents can form potent carcinogens.

Short Term Exposure Limit (STEL): 25 ppm for 15 minutes (ACGIH, 1992 - 93; OSHA, 1989). The ACGIH has proposed a 15 ppm STEL that may be adopted sometime after 1993.

Time Weighted Average (TWA) Limit: 10 ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989). The ACGIH has proposed a 5 ppm TWA with a "skin" notation that may be adopted sometime after 1993.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentrations of diethylamine vapors that may be present in air at the spill site and over potentially considerable downwind distances. Direct contact and ingestion should also be avoided. Alkyl substituted n-nitrosamines, known to be potent carcinogens, may be formed when diethylamine comes in contact with nitrous acid, inorganic or organic nitrites or atmospheres with high nitrous oxide concentrations. Although no supporting data for humans is available, diethylamine is known to be mutagenic in short-term tests with bacterial cultures.

Hazards of Skin or Eye Contact: Prolonged or repeated exposure of eyes to vapor concentrations in air too low to cause other effects may cause blue hazy vision and the appearance of halos around lights due to eventual swelling of eye tissues. The eyes usually return to normal the next day but intense exposures may require several days for recovery and entail discomfort and sensitivity to light. Contact of the eyes with liquid diethylamine or its mists may rapidly result in redness, intense pain, and chemical burns involving corneal scarring and clouding, glaucoma, cataracts, and possibly permanent blindness. Note that aqueous solutions containing as little as 1% diethylamine by weight are known to have caused corneal opacities in animal experiments. Brief contact of the skin with liquid diethylamine or its concentrated vapors may cause various degrees of skin irritation and/or inflammation. Prolonged contact, especially if covered as with wet clothing, may result in blisters, extensive burns, tissue destruction, and/or deep scarring. Prolonged or repeated contact is reported capable of resulting in sensitization of the skin such that some people may become allergic. Prolonged or widespread contact may also result in the absorption of harmful amounts through even intact skin, possibly causing liver and kidney damage. Be advised that corrosive effects on the skin and eyes may be delayed at times and that damage may occur without the sensation or onset of pain. All exposures should be treated on an emergency basis without delay. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Mists or vapors of diethylamine are irritating and corrosive to the nose, throat, and lungs. Effects of excessive exposure are reported to include inflamed tissues of the nose and throat, laryngeal edema, coughing, chest pain, shortness of breath, difficult breathing, bronchitis, nausea, muscle contractions or spasticity, liver and/or kidney injury, cyanosis, and possibly death. Severe exposures that are initially survived may result in pulmonary edema and chemical pneumonitis that may be delayed in onset and which may have severe consequences. Exposure to 4,000 ppm in air for 4 hours was lethal to 50% of rats in laboratory experiments. The NIOSH IDLH (1990) for diethylamine vapors is 2,000 ppm. Concentrations of diet$ylamine vapors directly over a pool of the liquid are approximately 131,600 ppm at 42.8°F (6°C); 263,150 ppm at 68°F (20°C); and 526,300 ppm at 100°F (37.8°C). Although it has not been shown that diethylamine has this effect, similar amines are known to cause allergic respiratory system sensitization of some people in long-term chronic exposures.

Hazards of Ingestion: Excessive ingestion of liquid diethylamine is reported to result in burns of the mouth, throat and respiratory tract, irritation and/or burns of the digestive tract, possible hemorrhages in the stomach wall, severe abdominal pain, nausea, vomiting, collapse, liver and kidney damage, and possibly death. Single oral dosages of 500 to 649 milligrams of diethylamine per kilogram of body weight are reported as being fatal to 50% of mice and rats in laboratory experiments.

FIRE HAZARDS

Lower Flammable Limit: 1.8%.

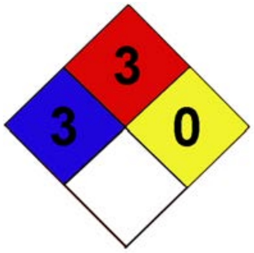
Upper Flammable Limit: 10.1%.

Behavior in Fire: Volatile flammable liquid. May generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently and possibly rocket in a fire.

Hazardous Combustion Products: Not well-defined; may include toxic and/or irritating gases and fumes including ammonia, carbon monoxide, carbon dioxide, various hydrocarbons, various amines, and very highly toxic oxides of nitrogen.

1154

DIETHYLAMINE
Class 3 (Flammable Liquid)



POTENTIAL HAZARDS *(CONTINUED)*
EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently and possibly rocket in a fire. Explosion may result if vapors are ignited in a confined area. Contact with certain other chemicals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product or its solutions. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials for diethylamine itself may include Silvershield, Teflon, and polyethylene/ethylene vinyl alcohol (PE/EVAL). Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: For unknown concentrations, fire fighting, general use, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister (500 ppm or less) or a chemical cartridge respirator with a full facepiece (500 ppm or less) may be adequate within the use limitations of these devices when equipped with appropriate canisters or cartridges providing appropriate protection against diethylamine.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, shortness of breath, nausea, vomiting, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes (a period of 30 - 60 minutes may be more appropriate), occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists or becomes apparent after washing. (Note: For ethylamine, a similar chemical, a major maker of the product says not to apply eye pads or pressure since this may cause "gluing" of the eyelids to the eyeball; 2 - 3 drops of a 0.5% pontocaine solution are permitted to relieve pain, after the relief of which eyes should be flushed with water or a 0.9% sodium chloride solution. The same source suggests rinsing the skin with vinegar or a 1 to 2% acetic acid solution after washing with water. The use of ointments or coverage of the injured area with clothing or a dry dressing is discouraged during the first 24 hour period. Instead, it is reported that the area may be covered with a dressing kept moist with a 0.9% sodium chloride solution.)

First Aid for Ingestion: Get medical attention immediately. If conscious, have victim wash out mouth with water (which should not be swallowed). If medical attention is not immediately available and victim is conscious, administer large quantities of water. Do not attempt to make the victim vomit. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs and repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol foam, water spray. Water may be ineffective but application of large quantities may dilute spills to nonflammable mixtures.

Extinguishing Techniques: Unusual corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent

SPILL RESPONSES *(CONTINUED)*

substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use. Take the corrosiveness, high flammability, high volatility, and toxic characteristics of diethylamine into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Diethylamine discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to diethylamine vapors may absorb vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of diethylamine from contact with its vapors.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of diethylamine vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION. . . The addition of large amounts of water to liquid diethylamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain liquids and neutralize and/or remove them as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES.. . Liquid diethylamine and its solutions may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Neutralize and/or remove liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

DIETHYLAMINE
Class 3 (Flammable Liquid)

LAND RESPONSES *(CONTINUED)*

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of afire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Do not operate motorized equipment in potentially flammable atmosphere. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Any spilled diethylamine will quickly dissolve in water. Be advised that potentially toxic and flammable vapors may evolve from the water surface for a time and travel in the downwind direction as the contaminated water moves downstream.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

DIETHYLAMINE
Class 3 (Flammable Liquid)

WATER SPILL *(CONTINUED)*

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Cation exchangers may be effective for use on neutral or acidic solutions.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

DIETHYL ETHER OR ETHYL ETHER

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Diethyl ether is a colorless, highly volatile, and flammable liquid with a sweet, pungent, and aromatic odor. It is the substance best known by the name "ether" and is used as an anesthetic, for priming gasoline engines, as an industrial solvent and extractant, in organic synthesis, and for several other purposes. It is fairly soluble in water and lighter, so can be expected to dissolve at an appreciable rate while also evaporating rapidly from the water surface. Its boiling point of approximately 94.1°F and flash point of -49°F indicate that diethyl ether is easily ignited under all ambient temperature conditions. Vapors of diethyl ether are heavier than air, may travel a considerable distance to a source of ignition and flash back and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6 pounds per gallon. Diethyl ether is lighter than water and therefore will float on water.

Diethyl ether does not react with water and is generally stable in normal transportation. It tends to form unstable and explosive peroxides when exposed for a time to heat, air and/or light, however, and may ignite, form a potentially explosive mixture, and/or spontaneously explode in contact with a wide variety of strong oxidizing agents. Additionally, it is reported to be incompatible with strong bases, is very sensitive to ignition by static electricity, and may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low but the volatility of diethyl ether indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

If diethyl ether is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; 7.5 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in lower aliphatic alcohols, acetone, benzene, chloroform, petroleum ether, solvent naphtha, other fat solvents, and many oils.

Specific Gravity (Liquid): 0.7134 - 0.7147 at 68°F (20°C)

Vapor Density: 2.56

Boiling Point: 94.1 - 94.3°F (34.5 - 34.6°C) at 1 atm.

Melting Point: -177.3°F (-116.3°C) for stable crystals; -189.9°F (-123.3°C) for metastable crystals.

Freezing Point: See melting point.

Molecular Weight: 74.12

Heat of Combustion: -8082 cal/g

Evaporation Rate (butyl acetate=1): 37.5

Vapor Pressure: 442 mmHg (8.54 psia) at 68°F (20°C)

Flash Point: -49°F (-45°C), closed cup; -40°F (-40°C),open cup

Autoignition Temperature: 320 - 374°F (160 - 190°C); reported values vary.

Burning Rate: 6.7 mm/minute

Flammable Limits: 1.9% (LEL) - 36.0% (UEL)

Stability: Stable in normal transportation but may decompose violently when heated. Product is especially sensitive to ignition by static electricity; when shaken under absolutely dry conditions, diethyl ether itself can generate sufficient static electricity to start a fire. Tends to form unstable explosive peroxides in prolonged presence of heat, air and/or light, especially if evaporated to dryness. These peroxides may explode spontaneously or when heated.

Polymerization Potential: Will not occur.

Corrosiveness: Generally noncorrosive to metals but may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: May react violently, ignite, form a potentially explosive mixture, and/or spontaneously explode in contact with a wide variety of strong oxidizing agents (including liquid air). Reacts with halogens, sulfur and sulfur compounds. Reported to be incompatible with strong bases.

IDENTIFICATION

Shipping Name(s): Diethyl ether (USDOT & IMO)or Ethyl ether (USDOT).

Synonyms and Tradenames: Diethyl oxide; Ethyl oxide; Sulfuric ether; Anesthetic or anesthesia ether; Solvent ether; Ether.

CAS Registry No.: 60-29-7

Chemical Formula: $CH_3CH_2OCH_2CH_3$

Constituent Components (% each): One maker reports its product to be 97% or more pure with remainder mostly ethyl alcohol.

UN/NA Designation: UN1155

IMO Designation: 3.1, Flammable liquids

RTECS Number: KI5775000

NFPA 704 Hazard Rating: 1(Health): 4(Flammability): 1(Reactivity) Note: Due to the reactivity of this material, some experts believe that the reported reactivity rating is conservative.

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid (boils at approx. 94.1°F)

Color of the Shipped Material: Colorless

Odor Characteristics: Sweet; pungent; aromatic; like ether.

Reportable Quantity: See appendix I.

Common Uses: Organic synthesis; industrial solvent and extractant; anesthetic; making of gun powder; alcohol denaturant; refrigerant; gasoline engine primer; in diesel fuels; in dry cleaning.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

DIETHYL ETHER OR ETHYL ETHER
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Most likely in range of 0.30 to 0.83 ppm; other reported values vary widely up to 1920 ppm.

Unusual Hazards: Highly volatile and flammable liquid with heavier than air vapors that may persist in pits, hollows, and depressions. The boiling point of diethyl ether is approximately 94.1°F. Tends to form explosive peroxides as reported above. Commonly explosive in contact with strong oxidizing agents. Very sensitive to ignition by static electricity.

Short Term Exposure Limit (STEL): 500 ppm (1520 mg/m^3) (ACGIH 1993-1994)

Time Weighted Average (TLV-TWA): 400 ppm (1200 mg/m^3)

Ceiling (C) Limit: Unavailable

IDLH: 1900 ppm or 10% LEL

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; exposure to air and light; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from prolonged inhalation of the very high vapor concentrations that may be present in air in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided. Note that overexposures may increase the severity of effects related to drinking alcoholic beverages.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid diethyl ether may result in drying and cracking of the skin due to the defatting action of the product. There is some unconfirmed potential for allergic sensitization of the skin. Brief contact usually causes mild irritation, if any. Although diethyl ether is said by one authority to be capable of being absorbed through the skin in amounts causing symptoms of inhalation, this is not generally considered to be a significant problem in humans. Contact of liquid diethyl ether with the eyes may cause a transitory smarting sensation and slight but reversible eye injury according to most authorities. One, however, reports there may be painful inflammation of a transitory nature. Do not wear contact lenses when working with diethyl ether.

Hazards of Inhalation: Exposure to high levels of diethyl ether vapors in air may cause irritation of the eyes, nose, and throat. Inhalation of very high concentrations in air may cause narcosis and central nervous system depression. Initial effects of acute overexposure may range from excitement to drowsiness, vomiting, paleness of the face, lowering of the pulse and body temperature, irregular respiration, muscular relaxation, and excessive salivation according to one expert source. Subsequent effects are said to be temporary and include vomiting, salivation, irritation of the respiratory passages, headache, and depression or excitation. Kidney injury is a possibility but has not been completely confirmed. Other possible symptoms listed by various authorities include dizziness, weakness, nausea, stupor, irregular heartbeat, jaundice, liver damage, unconsciousness, and possibly death from respiratory failure due to severe and continued exposures. Note that diethyl ether has been used as a surgical anesthetic for humans and is therefore not highly toxic by inhalation. A concentration of about 19,000 ppm in air is the lowest reported as necessary to induce anesthesia, while levels of 100,000 to 150,000 ppm are initially needed for this purpose in humans and 50,000 ppm is required to maintain the condition. In general, prolonged exposure to levels of 100,000 ppm or greater, this being 10% by volume in air, are required to cause fatalities. Continued inhalation of 2000 ppm simply causes dizziness. Exposure to 65,000 ppm for 100 minutes was necessary to kill 50% of mice in laboratory experiments

Hazards of Ingestion: Ingestion of diethyl ether is generally expected to cause many of the same effects as inhalation. More specific data are unavailable.

FIRE HAZARDS

Lower Flammable Limit: 1.9%

Upper Flammable Limit: 36.0%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Heat of nearby fire may possibly promote formation of unstable and explosive peroxides.

Hazardous Combustion Products: Not well-defined; said to produce acrid smoke, irritating fumes, carbon monoxide, carbon dioxide, explosive peroxides and possibly other toxic substances.

EXPLOSION HAZARDS

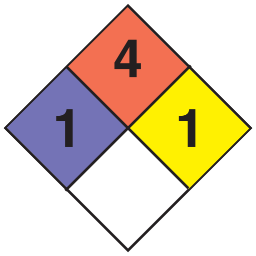
Explosive Limit: Unavailable

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with strong oxidizing agents may cause explosion. Exposure to heat, air, and/or light may produce unstable and explosive peroxides with time.

1155

DIETHYL ETHER OR ETHYL ETHER

Class 3 (Flammable Liquid)



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Polyvinyl (ALC) and Teflon® are reported to provide more than 8 hours of protection. Clothing materials listed as potentially compatible by various authorities include chlorinated polyethylene, Silvershield, neoprene/styrene-butadiene rubber, butyl rubber, nitrile rubber, polyethylene, and polyurethane.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 19,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge (19,000 ppm or less) with a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; symptoms of narcosis or central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Get medical attention if irritation persists after washing.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: One major authority suggests the above, a second suggests that vomiting not be induced, while a third recommends that vomiting only be induced if immediate medical attention is not available. Seek immediate medical advice on this issue if possible, realizing that all courses of action entail various risks to the victim.)

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, Halon, alcohol type concentrate foam, water spray. Water may be ineffective, but very large quantities may be used to dilute spill to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture violently and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of diethyl ether may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment. Take into account while planning the response that diethyl ether is a highly volatile and flammable liquid that may evaporate rapidly. Beware of possible heavy vapor accumulations in pits, hollows, or depressions. Protect diethyl ether from static electricity and lightning. Avoid direct sunlight and exclude air from recovered product if at all possible.

Pay special attention to the fact that unstable and explosive peroxides may form with time. Where necessary, such peroxides may be removed by treating the ether and contaminated surfaces with a ferrous sulfate solution. One authority suggests a solution made up in a ratio of 100 grams of ferrous sulfate to 8 ml of concentrated hydrochloric acid in 85 ml of water. Be especially careful with aged containers of diethyl ether that may have formed peroxides upon long standing and which may be very unstable. Similarly, keep in mind that peroxides may form in containment and cleanup equipment that is contaminated with diethyl ether and not properly decontaminated. This warning applies to all response techniques listed below.

DIETHYL ETHER OR ETHYL ETHER

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to diethyl ether vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain varying amounts of diethyl ether from contact with its vapors.

MITIGATION

Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

ALCOHOL TYPE CONCENTRATE FOAM . . . There is a possibility that alcohol type concentrate foam applied to the surface of liquid pools may slow the release of diethyl ether vapors into the atmosphere. (Note: Be advised that authorities are divided on whether alcohol or standard foam is more appropriate. It is likely that both are suitable to some degree.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid diethyl ether may slow the release of vapors into the atmosphere. The amount of water must be sufficient to completely dissolve the ether or the response will not be effective. Thus, be prepared to add 15-20 times (or more) as much water by weight as the amount of ether that has spilled.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

DIETHYL ETHER OR ETHYL ETHER

Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

DIETHYL ETHER OR ETHYL ETHER
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination. (Note: Diethyl ether is not only highly volatile in all but very cold weather but its solubility in water is appreciable. Although some authorities suggest the possibility of using oil spill type confinement and cleanup techniques for diethyl ether spills on water, such techniques would only be suitable under relatively unusual conditions and are therefore not listed below)

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

1,1-Difluoroethane is a flammable, colorless, and odorless gas or liquid (liquefied compressed gas). It is sometimes reported to have a slight ethereal odor. It is used as a cooling agent, in aerosols and in the manufacture of other chemicals. It is stable, although any source of ignition should be avoided. Incompatible materials include, but may not be limited to, hot metals, moisture, strong oxidizing agents, brass, steel, magnesium, aluminum and their alloys. It is practically insolubility in water.

1,1-Difluoroethane is essentially non-toxic. The primary route of entry is inhalation of the vapors, although the liquid form may cause frostbite-like burns to the eyes and skin. Inhalation in moderate amounts may cause headaches, drowsiness, dizziness, excitation, excessive salvation, vomiting and unconsciousness. Larger amounts may cause unconsciousness and death due to asphyxia. 1,1-Difluoroethane can affect the heart causing irregular rhythm and skipped heartbeat.

The flammability potential for 1,1-difluoroethane is high. It will readily ignite from any source of ignition, including static electricity and friction from escaping gas. Flammable mixtures are formed with air. Vapors are heavier than air, may travel to distant sources of ignition and flash back. Initial downwind evacuation should be considered for at least one-half (1/2) mile if product is leaking but not on fire. If container of 1,1-difluoroethane is exposed to direct flame or a fire becomes uncontrollable, evacuate for one (1) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble (.28%)
Solubility in Other Chemicals: Unavailable
Specific Gravity: 1.004 at -13°F (-25°C)
Vapor Density (Air=1): 2.4
Boiling Point: -16.6°F (-27°C)
Melting Point: -179°F (-117°C)
Freezing Point: See melting point
Molecular Weight: 66.05
Heat of Combustion: Unavailable
Vapor Pressure: 4,550 mm Hg at 77°F (25°C)
Flash Point: < -58°F (-50°C), burns at all ambient temperatures.
Autoignition Temperature: 849°F (454°C)
Burning Rate: Unavailable
Flammable Limits: 3.7% (LEL) - 18% (UEL)
Stability: Stable. Avoid sparks or flame source that can cause ignition.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with hot metals and moisture; strong oxidizing agents; magnesium, aluminum and their alloys; brass and steel.

IDENTIFICATION

Shipping Name(s): 1,1-Difluoroethane (USDOT & IMO); Refrigerant gas R152a (USDOT)
Synonyms and Tradenames: Difluoroethane; Difluoroethane, 1,1-; Ethylidene difluoride; Ethylidene fluoride; Fluorocarbon 152a; Freon 152a; Genetron 100; Genetron 152a; R-152a; Ethylene fluoride
CAS Registry No: 75-37-6
Chemical Formula: $C_2H_4F_2$
Constituent Components (% each): 100%
UN/NA Designation: UN1030
IMO Designation: 2.1, Flammable gases
RTECS Number: KI1410000
NFPA 704 Hazard Rating (Gas): 1 (Health): 4 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Compressed gas or liquid
Physical Form as Released: Gas or liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless to slight ethereal odor
Common Uses: It is used as a cooling agent, in aerosols and in the manufacture of other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Typically odorless

Unusual Hazards: Highly flammable. Liquid form of 1,1-difluoroethane can cause frost-like burns. Inhalation of large concentration of gas may cause dizziness, drowsiness and unconsciousness.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable (Simple asphyxiant)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity and incompatible materials.

HEALTH HAZARDS

Potential Health Hazards: 1,1-Difluoroethane has no toxicity reported except that it may asphyxiate and cause frost-like burns with skin or eye contact. 1,1-Difluoroethane can affect the heart causing irregular rhythm and skipped heartbeat.

Hazards of Skin or Eye Contact: Eye or skin contact with liquid can cause frostbite type injury due to rapid cooling from evaporation. Prolonged or repeated contact can cause drying and cracking of the skin.

Hazards of Inhalation: Breathing 1,1-difluoroethane can irritate the nose and throat causing coughing and wheezing. Moderate concentrations may cause headache, drowsiness, dizziness and unconsciousness. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema) with severe shortness of breath. In confined areas, vapors can accumulate and cause unconsciousness and death due to displacement of oxygen (simple asphyxia).

Hazards of Ingestion: Ingestion is unlikely due to physical properties of 1,1-difluoroethane. Contact with the extremely cold liquid would, at the very least, cause frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 3.7%

Upper Flammable Limit: 18%

Behavior in Fire: Flammable gas. It will readily ignite if exposed to sources of heat and flame. Vapors may be heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity and other potential ignition sources at locations distant from the point of release. Containers exposed to prolonged fire or heat may violently rupture.

Hazardous Decomposition Products: Products of combustion may include carbon monoxide, carbon dioxide, hydrogen fluoride, hydrofluoric acid, phosgene and/or carbonyl fluoride. Toxic products may become corrosive in the presence of moisture.

EXPLOSION HAZARDS

Explosive Potential: High. Severe explosion hazard when exposed to heat, flame or oxidizers. Explosive when mixed with air. Escaping gas may ignite spontaneously due to friction. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged fire or heat may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

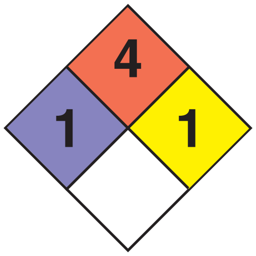
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1030

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: 1,1-Difluoroethane is relatively inert. Contact of liquid with skin or eyes may cause frost-like burns. Inhalation is the major route of exposure and can cause headache, drowsiness, dizziness and unconsciousness.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact with cold liquid, remove contaminated clothing and wash affected body areas with large amounts of warm water. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming such as wrapping effected area gently in blankets if warm water is not available. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Ingestion is unlikely. If liquid is ingested, frostbite-like injury can occur. Drink warm water to relieve frostbite, but do not induce vomiting without medical supervision. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

FIRE RESPONSE

Extinguishing Agents: Stop the flow of gas. Use carbon dioxide, dry chemical or water spray (fog). A fine water spray or fog can be used on large discharges to control the fire by preventing its spread and absorbing some of its heat. Do not apply water streams directly on a 1,1-difluoroethane pool fire since this may greatly and/or suddenly increase the rate of burning and/or the size of the fire by increasing the vaporization rate of the liquid.

Extinguishing Techniques: Stay upwind. Secure ignition sources in the immediate spill area and downwind. Approach fire from upwind to avoid flammable vapors. Wear positive-pressure, self-contained breathing apparatus and appropriate protective clothing. Wear full chemical and/or thermal protective suit as necessary and appropriate. Move container from fire area if no risk. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to prolonged heat, such as from a direct flame. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable gases.

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)

SPILL RESPONSES

General Information: 1,1-Difluoroethane is highly flammable. Eliminate all sources of ignition. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with very cold gas or liquid unless properly equipped for such contact. If transfer operations are anticipated, only use equipment specifically designed for use with the material being transferred and its temperature and pressure at the time of transfer. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows and depressions. Use combustible gas detectors prior to entering any potentially affected confined space or any low area in which cold, heavier-than-air gases or vapors may have accumulated. Do not direct water at a venting safety device since this may cause icing to occur. Note that the rapid escape of gas under pressure may generate a static electricity charge that could cause gas ignition. Be advised that the very low temperatures associated with 1,1-difluoroethane can cause many materials to become brittle and subject to sudden failure or cracking. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ mile in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)

TECHNIQUE

FOAM . . . Foam can be applied in large volumes to the surface of confined pools to slow the rate of vapor evolution, particularly after boiling pools have quieted down. Be advised of the possibility of a short-term increase in vapor evolution when the foam (which will be warmer than the liquid) is first applied.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to the soil, initially liquid will rapidly boil, generate a large amount of flammable vapors and freeze the ground it is in contact with. Much later, the liquid will reach a less rapid boiling rate thereby evolving less vapors. Containment dikes or barriers using soil, sand or other related materials may be effective to confine the spill to a limited area thereby reducing the surface area and volume of gas generated until liquid evaporates. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material.

CONSEQUENCE

Contained material will take longer to evaporate.

MITIGATION

Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater, which may overfill diked areas.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches. Reducing the spill surface area may decrease vapor generation.

CONSEQUENCE

Contained material will take longer to evaporate. Mechanical equipment could ignite material.

MITIGATION

Continually monitor for flammable conditions. Dig a deep pit with small area to reduce vapor generation rate. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill pits.

TECHNIQUE

MECHANICAL REMOVAL . . . Most if not all the product will rapidly vaporize from soil surfaces once the bulk of the liquid has vaporized. Mechanical equipment can be used to grade frozen ground to eliminate any pockets of material.

CONSEQUENCE

Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Continually monitor for flammable conditions.

1,1-DIFLUOROETHANE

Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake and monitor situation.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

MONITOR THE SITUATION . . . 1,1-Difluoroethane may vigorously and rapidly boil off the surface of water bodies.

CONSEQUENCE

Flammable concentrations will exist in the area before time and distance from the area of the spill has diluted the gas.

MITIGATION

Evacuate area affected and continually monitor until conditions are safe.

March 1995

DIISOBUTYLENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Diisobutylene is a clear colorless liquid hydrocarbon with an odor comparable to gasoline or petroleum. It is used to make antioxidants, surfactants, plasticizers, lube additives, and other chemicals. Essentially insoluble in water, diisobutylene will float to form a surface slick. Its flash point is in the range of 10-23°F, thus indicating that it can be easily ignited under most ambient temperature conditions. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6 pounds per gallon.

Diisobutylene does not react with water or other common materials but is reactive with a variety of chemicals and certain active metals. The toxicity of the substance is generally considered low to moderate via various routes of exposure but is not very well defined. Toxic vapors may evolve if diisobutylene is heated to the point of decomposition. Downwind evacuation should be considered on a case by case basis if diisobutylene is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Essentially insoluble.
Solubility in Other Chemicals: Data unavailable.
Specific Gravity (Liquid): 0.715 at 68°F (20°C)
Boiling Point: 214-219°F (101-104°C) at 1 atm.
Melting Point: -150°F (-101°C)
Freezing Point: -136.3°F (-93.5°C)
Molecular Weight: 112.22
Heat of Combustion: -10500 cal/g
Vapor Pressure: 75 mm Hg (1.45 psia) at 100°F (37.8°C)
Flash Point: 10 to 23°F (-12.2 to -5°C), closed cup
Autoignition Temperature: 736-788°F(391-420°C)
Burning Rate: 7.9 mm/minute
Stability: Stable
Corrosiveness: Data unavailable.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with mineral acids, aldehydes, certain active metals, and strong oxidizers.

IDENTIFICATION

Shipping Name: Diisobutylene (USDOT and IMO)
Synonyms and Tradenames: Isomeric compounds; 2,4,4-trimethylpentene; diisobutene; 2,4,4-trimethyl-1-pentene; alpha-diisobutylene; beta-diisobutylene; 2,4,4-trimethylpentene-1, 2,4,4-trimethylpentene-2. (Note: product may be mixture of isomers.)
Chemical Formula: $(CH_3)_3CCH_2C(CH_3){=}CH_2$
Constituent Components(% each): 98.7-99.9% pure with isobutylene as probable major contaminant.
UN/NA Designation: UN2050
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Like gasoline or petroleum
Common Uses: Mfg. of antioxidants, surfactants, lube additives, plasticizers, rubber chemicals, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DIISOBUTYLENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Moderately volatile flammable liquid. Vapors may be heavier than air and may travel to a source of ignition and flashback. May evolve toxic vapors when heated to decomposition.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, open flames, and sparks; runoff to sewers or water; contact with incompatible materials; inhalation, ingestion, and direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air but diisobutylene may be considered a mild inhalative toxin in acute exposures.

Hazards of Skin or Eye Contact: Liquid diisobutylene is considered slightly to moderately irritating to the skin and eyes.

Hazards of Inhalation: Vapors of diisobutylene are irritating to the eyes, nose, and throat. High concentrations in air may cause narcosis involving dizziness, headache, difficult breathing or loss of consciousness. Very high levels may cause asphyxiation.

Hazards of Ingestion: Ingestion may cause nausea and vomiting.

FIRE HAZARDS

Lower Flammable Limit: 0.8%

Upper Flammable Limit: 4.8%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: There is some potential for containers to rupture violently in fires. Explosions may also result if vapors are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Vapor exposure may cause eye, nose, and throat irritation, dizziness, headache, difficult breathing, or loss of consciousness. Liquid is irritating to the skin and eyes. Ingestion may cause nausea and vomiting.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

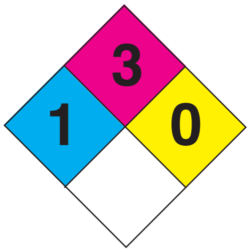
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

2050

DIISOBUTYLENE

Class 3 (Flammable Liquid)



FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Use explosion-proof equipment where necessary. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of diisobutylene may result in rupture or explosion of boilers or industrial process equipment. Take into account while planning the response that diisobutylene is a flammable liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Diisobutylene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of diisobutylene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Diisobutylene spills may expose downwind areas to toxic or flammable concentrations if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to diisobutylene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of diisobutylene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

DIISOBUTYLENE
Class 3 (Flammable Liquid)

TECHNIQUE

FOAM ... Firefighting foam applied to the surface of liquid pools may slow the release of diisobutylene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Diisobutylene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained diisobutylene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the over all volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

DIISOBUTYLENE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS ... Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across streams and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled products.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS ... Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

DIISOBUTYLENE
Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION ... Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING ... Oil spill skimming devices may be deployed to recover floating diisobutylene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION ... Straw, hay, peat, or commercial sorbent materials compatible with diisobutylene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

July 1994

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Diisopropylamine is a clear, colorless liquid with a strong ammonia-like odor. It has a low flash point and its vapors may travel a considerable distance to a source of ignition. Vapors are easily ignited by flame, sparks, or static discharges. The vapors are denser than air and may concentrate in low lying areas or confined spaces. Diisopropylamine is completely soluble in water and, when mixed with water, will dilute and disperse throughout the water column. It is not particularly reactive unless mixed with strong acids or oxidizers. Diisopropylamine is not subject to violent polymerization. Its vapors can ignite explosively, particularly in confined settings. Liquid diisopropylamine weighs approximately 6 pounds per gallon.

Diisopropylamine is toxic by ingestion, inhalation, and absorption. On direct contact, it will produce strong irritation or burns to the skin, eyes or other mucous membranes. If vapors are inhaled, diisopropylamine will cause irritation to the respiratory tract. Severe inhalation exposures may result in the development of pulmonary edema. Ingestion will likely produce nausea, vomiting, abdominal distress, and diarrhea. Diisopropylamine is a skin and respiratory sensitizer and repeat exposures may result in the development of an allergic response. Persons previously sensitized to diisopropylamine may be at increased risk from exposures.

Diisopropylamine is used as a chemical intermediate in the manufacture of pharmaceuticals, pesticides, and as a laboratory reagent.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble.

Solubility in Other Chemicals: Soluble in most organic solvents.

Specific Gravity (Liquid): 1.54

Vapor Density (Air =1): 3.5

Boiling Point: 83.4 to 84.1°C (182.12 to 183.38°F)

Melting Point: - 61 to - 96.3°C (- 77.8 to - 141.34°F)

Freezing Point: - 61 to - 96.3°C (- 77.8 to - 141.34°F)

Molecular Weight: 101.19

Heat of Combustion: - 11,000 cal/gm

Vapor Pressure: 60 - 70 mmHg @ 20°C (68°F)

Flash Point: -13.3°C (8°F) CC; - 6.1°C (21°F) OC

Autoignition Temperature: 316 to 402.2°C (600.8 to 755.96°F)

Burning Rate: Unavailable.

Stability: Stable, not subject to polymerizarion.

Corrosiveness: Alkaline liquid, corrosive to skin, corrosive to copper and copper alloys, zinc and zinc alloys.

Reactivity with Water: Completely soluble, no reaction.

Reactivity with Other Chemicals: Reactive with oxidizers, acids, anhydrides, and acid chlorides.

IDENTIFICATION

Shipping Names: Diisopropylamine.

Synonyms and Tradenames: N-(1-Methylethyl)-2-propanamine; 2-propanamine, N-(1-methylethyl), DIPA; DIPN; CAS 108-18-9.

Chemical Formula: $[(CH_3)_2CH]_2NH$

Constituent Components (% each): 100% diisopropylamine.

UN/NA *Designation:* UN1158

IMO Designation: 3.2, flammable liquid.

Physical State as Shipped: Liquid.

Physical State as Released: Liquid.

Color of the Shipped Material: Clear, colorless, waterwhite.

Odor Characteristics: Amine odor, ammonia-like, irritating.

Common Uses: Chemical intermediate and catalyst. Used in the manufacture of pesticides and pharmaceuticals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424- 9300 OR (202) 483- 7616

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.85 ppm (3.4 mg/m^3)

Unusual Hazards: Diisopropylamine is flammable and will irritate or burn tissues. It is a skin and respiratory sensitizer and repeated exposures may result in the development of allergic reactions.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): 5 ppm (20 mg/m^3) skin, OSHA PEL - TWA

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Toxic by inhalation and skin absorption. Direct contact with diisopropylamine or direct contact with contaminated materials is the most likely route of exposure. It is an irritant and a sensitizing agent. It may act as a contact allergen in sensitive individuals. There is an increased risk to persons with pre-existing conditions such as known sensitivity to diisopropylamine, asthma or allergies.

Hazards of Skin and Eye Contact: Exposure to vapors may be irritating. Exposure to liquid or mists can cause corneal damage and transient corneal edema. Severe exposures may result in burns to eye tissues. May cause irritation to the skin and, in severe, prolonged exposures, may cause burns to the skin. Diisopropylamine can be absorbed through intact skin on repeated or prolonged exposures. It is a skin sensitizer and repeated exposures may result in the development of an allergic reaction. Sensitive individuals may develop itching or rash on exposure to small amounts of diisopropylamine.

Hazards of Inhalation: May cause irritation to respiratory mucous membranes, coughing, wheezing, or other signs of irritation. By analogy with other amines, toxic effects may include nausea, faintness, headache and anxiety. As a group, amines tend to affect the sympathetic nervous system. Exposures may aggravate pre-existing respiratory conditions such as asthma or allergies. In sensitized individuals, diisopropylamine may elicit an allergic response such as development of a skin rash or various degrees of respiratory response such as wheezing and asthma. Allergic responses will vary depending on the sensitivity of the individual exposed but could become life threatening. Exposure to extremely high concentrations may result in lung damage.

Hazards of Ingestion: May result in severe irritation or burns of the mouth, throat, stomach and associated tissue, depending on the concentration. Exposures may cause nausea, vomiting, and gastrointestinal distress. Ingestion of diisopropylamine may produce symptoms including dizziness, light headedness, and nervousness or anxiety.

FIRE HAZARDS

Lower Flammable Limit: 0.8%

Upper Flammable Limit: 7.1 %

Behavior in Fire: Smoke may contain toxic and irritating vapors. Vapors are heavier than air and will tend to collect in confined spaces or low lying areas. Vapor concentrations may present a source for ignition and flashback to the source under circumstances favoring vapor buildup. Sealed containers, exposed to heating, may rupture.

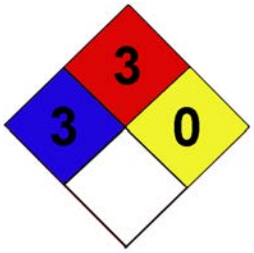
Hazardous Combustion Products: Ammonia, unburned product, oxides of carbon and other constituents.

EXPLOSION HAZARDS

Explosiveness: Vapor mixtures within the flammable limits may ignite explosively. Not subject to violent polymerization.

1158

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with diisopropylamine liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully encapsulating suits made of compatible material are appropriate for most large spill situations. Data are limited, however, nitril rubber, teflon, and viton have been suggested as suitable materials of construction.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

FIRST AID

Nonspecific Symptoms: Irritation or bums to skin, eyes and respiratory tract. Irritation or burns to mouth, throat and stomach, gastrointestinal distress, nausea, vomiting, dizziness and difficulty breathing in cases involving accidental ingestion.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure resulting in increased respiratory distress with time. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance immediately. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists or exposure is severe.

First Aid for Ingestion: Do not induce vomiting. If victim is conscious, administer large quantities of water or milk. Never give anything by mouth to an unconscious person. Seek medical assistance immediately. Be alert to signs of difficulty in breathing, nervousness or other indications of systemic toxicity.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, compatible mufti-purpose foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective as a firefighting agent but may be used to dilute mixtures to a non-flammable concentration. Diluting with water will add significantly to the spill volume.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with diisopropylamine. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water may be ineffective. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam is appropriate for fires involving diisopropylamine.

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)

SPILL RESPONSES

General Information: Diisopropylamine is highly flammable and easily ignited. Response strategies should account for the fact that flammable vapors are heavier than air and may travel some distance to a source of ignition. Intact containers containing diisopropylamine may rupture violently if exposed to extreme heat or fire. When spilled in water, diisopropylamine is completely soluble and will tend to disperse in the water column. All spill responses should consider that until the product is removed to safe containers, ignition is possible. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of diisopropylamine may result in explosion. Use only spark proof tools when working around diisopropylamine. Be sure lighting systems are of explosion proof design (intrinsically safe). Be alert to sources of ignition and static electrical discharge. Ground all transfer equipment to prevent static charge buildup.

AIR SPILL

TECHNIQUE

EVACUATION... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Diisopropylamine spills may expose downwind areas to toxic or flammable concentrations depending on the temperature and the size of the spill. Increased spill surface will result in increased vapor generation.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION... Diisopropylamine may not evolve large amounts of hazardous airborne contaminants depending on the air temperature and the size of the spill. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of diisopropylamine vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

MITIGATION

Remove spilled diisopropylamine as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for diisopropylamine vapor concentration.

TECHNIQUE

WATER FOG OR SPRAY... Water fog applied to diisopropylamine vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks:

CONSEQUENCE

Water runoff may contain diisopropylamine from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)

AIR SPILL *(CONTINUED)*

TECHNIQUE

FOAM... Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of diisopropylamine vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with diisopropylamine.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Spills of diisopropylamine liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Diisopropylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking diisopropylamine.

CONSEQUENCE

Diisopropylamine may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION... Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Diisopropylamine is highly flammable and explosion proof (intrinsically safe) equipment must be used.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

DIISOPROPYLAMINE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

TECHNIQUE

ABSORPTION... Spilled diisopropylamine can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbents.

CONSEQUENCE

Sorbents will become contaminated with diisopropylamine and will pose the same hazards as the spilled product. Use of sorbents will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbents to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL... Soil contaminated with diisopropylamine may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines. Explosion proof (intrinsically safe) equipment must be used due to the high flammability of diisopropylamine.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Removed materials may pose a continued risk of fire or contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE... Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION... Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

January 1990

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Diisopropyl ether is a colorless, highly volatile, and flammable liquid with a sweet, pungent, pleasant, and slightly sharp odor resembling the chemical commonly referred to as "ether". It is used as a solvent for oils, waxes and resins, as an extractant, and in paint and varnish removers and rubber cements. Only slightly soluble in water and lighter, it can be expected to form a surface slick that dissolves at a relatively slow rate while also evaporating from the water surface. Its flash point of –18°F indicates that diisopropyl ether is easily ignited under all ambient temperature conditions. Vapors of diisopropyl ether may be heavier than air, particularly in warm weather, and may in any case travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6–6.1 pounds per gallon.

Diisopropyl ether does not react with water and is generally stable in normal transportation. It tends to form unstable and explosive peroxides when exposed to air for a time under various conditions, however, and may react vigorously or ignite (explosion must be considered a possibility) in contact with a variety of strong oxidizing agents. Known to react violently with propionyl chloride, the product is not generally considered corrosive to metals but may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low, but the volatility of diisopropyl ether indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

If diisopropyl ether is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 1.2 g/100 g water, 0.02% wt, or 9000 mg/l at 68°F (20°C); 0.65% wt at 77°F (25°C); reported values vary.

Solubility in Other Chemicals: Soluble in alcohol, acetone, benzene, chloroform, ethyl ether, and most other organic solvents.

Specific Gravity (Liquid): 0.724–0.730 at 68°F (20°C)

Boiling Point: 153.5–156.2°F (67.5–69°C) at 1 atm.

Melting Point: –124.4°F to –122.6°F (–86.9 to –85.9°C) or –76°F (–60°C); reported values vary

Freezing Point: See melting point

Molecular Weight: 102.18

Heat of Combustion: –9390 cal/g

Vapor Pressure: 120 –130 mm Hg (2.32–2.51 psia) at 68°F (20°C)

Flash Point: –18°F (–27.8°C), closed cup; –15°F (–26.1°C), open cup

Autoignition Temperature: 830°F (443°C)

Burning Rate: 5.0 mm/minute

Stability: Stable in normal transportation but tends to form unstable explosive peroxides which precipitate as crystals in prolonged presence of air, especially if evaporated to dryness or heated. These peroxides may explode spontaneously or when heated or shaken. A partially filled old bottle on a shelf is known to have exploded when its stuck cap was freed.

Corrosiveness: Specific data unavailable; expected to be generally noncorrosive to metals but able to attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react vigorously or ignite (explosion must be considered a possibility) in contact with a variety of strong oxidizing agents. Reported to react violently with propionyl chloride.

IDENTIFICATION

Shipping Names: Diisopropyl ether (USDOT and IMO)

Synonyms and Tradenames: Isopropyl ether; diisopropyl oxide; 2,2'-oxybispropane; 2-isopropoxypropane

Chemical Formula: $(CH_3)_2CHOCH(CH_3)_2$

Constituent Components (% each): 94% or more pure with small amount of p-benzylaminophenol, hydroquinone, or other inhibitor added to prevent peroxide formation in normal transportation.

49 STCC: 49 081 95

UN/NA Designation: UN1159

IMO Designation: 3.1, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Like ether; sweet; pungent; slightly sharp; pleasant

Common Uses: Solvent for oils, waxes, and resins; extractant; in paint and varnish remover; in rubber cements.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.017–0.053 ppm

Unusual Hazards: Highly volatile and flammable liquid with heavier than air vapors. Tends to form explosive peroxides when exposed to air for a time or when evaporated to dryness or heated.

Short Term Exposure Limits (STEL): 310 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 250 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with air or incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid diisopropyl ether may result in drying and cracking of the skin due to the defatting action of the product. Brief contact pauses mild irritation, if any. Contact of liquid diisopropyl ether with the eyes may cause irritation and possibly minor injury according to most authorities, but at least one maker of the product claims the irritation may be severe. Do not wear contact lenses when working with diisopropyl ether.

Hazards of Inhalation: Exposure to high levels of diisopropyl ether vapors in air may cause irritation of the eyes, nose, and throat. Inhalation of very high concentrations in air may cause narcosis and central nervous system depression. Reported effects for this product include dizziness, weakness, fatigue, nausea, headache, tremors, anesthesia, unconsciousness, and possibly death in severe cases. Exposure to 30,000 ppm for 60 minutes was survived by monkeys, rabbits, and guinea pigs with signs of anesthesia in laboratory experiments. Similar experiments resulted in death of the animals when the exposure involved 60,000 ppm for 60 minutes. A level of 16,000 ppm was lethal to rats in four hour exposures. Exposure of humans to 800 ppm for five minutes resulted in irritation of the eyes and nose and some respiratory discomfort in sensitive individuals.

Hazards of Ingestion: Diisopropyl ether is generally of low toxicity by ingestion. Intake of a significant amount, however, may result in intense and rapid intoxication involving gastrointestinal irritation, nausea, vomiting, diarrhea, various symptoms of inhalation, and possibly death due to respiratory failure.

FIRE HAZARDS

Lower Flammable Limit: 1.4%

Upper Flammable Limit: 7.9% or 21% (most sources give 7.9%)

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined; said to produce acrid and irritating smoke and fumes, carbon monoxide, carbon dioxide, and possibly other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Exposure to air may produce unstable and explosive peroxide crystals with time.

1159

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Clothing materials listed as potentially compatible by various authorities include chlorinated polyethylene, polyvinyl alcohol, neoprene, nitrile rubber, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (10,000 ppm or less) or a chemical cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; symptoms of narcosis or central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, Halon, alcohol foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of diisopropyl ether may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that diisopropyl ether is a volatile flammable liquid. Exclude air from recovered product if at all possible. Pay special attention to the fact that unstable and explosive peroxides may form with time if diisopropyl ether is exposed to air, particularly if the product is evaporated to dryness or heated. Where necessary, peroxides may be removed by treatment with a sodium sulfite solution. Consult qualified expert for advice. Be especially careful with aged containers of diisopropyl ether that may have formed peroxides and which may be very unstable. Similarly, keep in mind that peroxides may form in containment and cleanup equipment that is contaminated with diisopropyl ether and not properly decontaminated. This warning applies to all response techniques listed below.

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Diisopropyl ether spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Diisopropyl ether spills may not evolve large amounts of toxic airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed or fully evaporates, particularly for smaller spills and where flammability hazards are limited.

CONSEQUENCE

Hazardous levels of diisopropyl ether in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to diisopropyl ether vapors in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain small amounts (if any) of diisopropyl ether from contact with its airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of diisopropyl ether vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE .

CONTAINMENT DIKES . . . Diisopropyl ether may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained diisopropyl ether may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, vermiculite, perlite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Diisopropyl ether is quite volatile and will evaporate from the water surface fairly rapidly in all but cold weather. Nevertheless, its solubility is water is limited. Time may permit the application of the oil spill type containment and cleanup techniques listed below for floating surface slicks in some cases when containment or recovery is considered desirable.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

DIISOPROPYL ETHER
Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, or small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating diisopropyl ether.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with diisopropyl ether may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Anhydrous dimethylamine is a colorless flammable gas that is shipped under pressure as a liquid and has a fishy odor resembling ammonia. It is used for making leather, rubber, detergents; pesticides, plastics, pharmaceuticals, photographic developers, and a variety of other chemicals and products. Its flash point of 20°F indicates that the product is easily ignited under a wide range of ambient temperature conditions. Its boiling point of 44.4°F and its considerable vapor pressure indicate that dimethylamine will boil or otherwise evaporate rapidly upon release. Nevertheless, since the product is fully soluble in water, spills onto water may result in some amount of dissolution. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.6 pounds per gallon at its boiling point.

Anhydrous dimethylamine does not react with water or many other common materials in a hazardous fashion and is stable in normal transportation. The product is reactive with a variety of chemicals, however, and may form an explosive mixture with mercury. In addition, it is corrosive to various metals, may attack some forms of plastics, rubber and coatings, and is irritating and corrosive to bodily tissues. Products of combustion may include toxic oxides of nitrogen and other toxic constituents.

Downwind evacuation should be considered if dimethylamine is leaking but not on fire. If fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in ethanol and ether
Specific Gravity (Liquid): 0.671 at 68°F (20°C)
Boiling Point: 44.4°F (6.9°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –134°F (–92.2°C)
Molecular Weight: 45.08
Heat of Combustion: –9340 cal/g
Vapor Pressure: 1.72 atm (25.27 psia) at 68°F (20°C)
Flash Point: 20°F (–6.7°C), closed cup
Autoignition Temperature: 756°F (402°C)
Burning Rate: 4.5 mm/minute
Stability: Stable
Corrosiveness: Corrosive to copper and its alloys, aluminum, zinc and galvanized surfaces. May attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction, but evolves some heat. Solution is alkaline and corrosive. Eventually degrades to ammonia in water.
Reactivity with Other Chemicals: Reacts with mercury, strong oxidizers, strong acids, halogens, some cleaning solutions, and nitrosating agents like sodium nitrite. Reaction with mercury may be explosive.

IDENTIFICATION

Shipping Names: Dimethylamine, anhydrous (USDOT); dimethylamine (IMO).
Synonyms and Tradenames: N-Methylmethanamine; DMA.
Chemical Formula: $(CH_3)2NH$
Constituent Components(% each): 99.5% pure
49 STCC: 49 055 10
UN/NA Designation: UN1032
IMO Designation: 2.1, flammable gas
Physical State as Shipped: Compressed liquefied gas
Physical State as Released: Gas or liquid (boils at 44.4° F)
Color of the Shipped Material: Colorless
Odor Characteristics: Fishy, pungent, strongly ammoniacal
Common Uses: Leather tanning; rubber vulcanization accelerator; mfg. detergents, pharamaceuticals, pesticides, photographic developer, plastics, and other chemicals and products; used as solvent and polymer stabilizer; component of rocket propellant and other fuels.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424`9300 OR (703) 527-3887 (COLLECT)

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.01–0.06 ppm

Unusual Hazards: Extremely volatile and flammable substance with heavier than air vapors that may travel a considerable distance to a source of ignition and flash back. Vapors may be toxic over considerable downwind distances. Product may explode in contact with mercury.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and over considerable downwind distances. Ingestion and direct contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of liquid anhydrous dimethylamine or its concentrated vapors with the skin may rapidly result in chemical burns and possibly frostbite. Contact with the eyes may cause irritation, impaired vision, and/or severe corneal injury.

Hazards of Inhalation: Vapors of dimethylamine are severely irritating to the lungs, nose, throat, and eyes, and may cause coughing, sneezing, and difficult breathing. High concentrations in air may result in pulmonary edema and liver injury with possibly severe consequences. Very high concentrations may cause asphyxiation due to displacement of air.

Hazards of Ingestion: Ingestion is unlikely but may result in burns of the mouth, throat, and stomach.

FIRE HAZARDS

Lower Flammable Limit: 2.8%

Upper Flammable Limit: 14.4%

Behavior in Fire: Flammable compressed or liquefied gas. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flashback. Containers may rupture violently in fire.

Hazardous Combustion Products: Include toxic oxides of nitrogen and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Contact with mercury may result in formation of explosive mixtures. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with very high gas or vapor concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister for dimethylamine or a dimethylamine cartridge respirator with a full facepiece within the use limitations of these devices.

1032

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas. Carbon dioxide, dry chemical, alcohol foam, and water spray may be used on fires involving water solutions of dimethylamine.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of warm water to exposed pools of liquid anhydrous dimethylamine may increase vapor evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected. personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile, flammable, and corrosive nature of dimethylamine into account while planning the response. Do not use equipment containing mercury. Note that accumulations of heavy gas may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Anhydrous dimethylamine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to anhydrous dimethylamine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not let it contact pools of liquid anhydrous dimethylamine as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain dimethylamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of cold water to liquid anhydrous dimethylamine may eventually slow the release of vapors or fumes into the atmosphere. The response has very special risks and is better suited to smaller spills.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Anhydrous dimethylamine may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained anhydrous dimethylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Wet or warm sorbents may increase vapor evolution from contained pools of liquid anhydrous dimethylamine.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert. Proceed with caution if sorbents are wet or warm.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involve additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

` Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

DIMETHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. Cation exchanges may be used on neutral or acidic solutions.

CONSEQUENCE

Recovery of adsorbents may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2003

2-DIMETHYLAMINOETHANOL

Class 8 (Corrosive Material)

GENERAL INFORMATION

2-Dimethylaminoethanol is a flammable, colorless to pale liquid that has a pungent, amine-like odor. The product is a hygroscopic liquid and is fully soluble in water. It is also soluble in ethyl alcohol, acetone, ether and benzene. It is used in medications and for making dyestuffs, textiles, pharmaceuticals and emulsifiers in paints and coatings. It is flammable and highly reactive with oxidizing agents, acids, acid anhydrides, acid chlorides, cellulose nitrate, isocyanates, nitrous acid, nitrites, copper, copper alloys, zinc and galvanized iron and steel. The product weighs approximately 7.4 pounds per gallon.

2-Dimethylaminoethanol is stable in normal transportation. It may be slowly oxidized by air, turning yellow and then brown. The product and its vapors are highly corrosive to all bodily tissue. Toxic vapors of nitrogen oxides, carbon monoxide and carbon dioxide are generated when product is heated to decomposition. Note that fumes and vapors may be heavier than air.

Initial downwind evacuation should be considered on a case by case basis if the product is leaking and large amounts of fumes are generated. If container of 2-dimethylaminoethanol is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble
Solubility in Other Chemicals: Soluble in all proportions in ethyl alcohol, acetone, ether and benzene.
Specific Gravity (Liquid): 0.887
Vapor Density: 3.1
Boiling Point: 282°F (139°C)
Melting Point: -94°F (-70°C)
Freezing Point: See melting point
Molecular Weight: 89.14
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): .48
Vapor Pressure: 6 mm Hg at 68°F (20°C); 100 mm Hg at 178.7°F (81.5°C)
Flash Point: 100°F (38°C) c.c.; 106°F (41°C) 41°C o.c.
Autoignition Temperature: 563°F (295°C)
Burning Rate: Unavailable
Flammable Limits: 1.9% (LFL) - 13.4% (UFL)
Stability: Stable. It may be slowly oxidized by air, turning yellow and then brown.
Polymerization Potential: Will not occur
pH: 11-12
Reactivity with Water: Although it is not reactive with water it is a hygroscopic liquid.
Reactivity and Incompatibility: Reacts with oxidizing agents, acids, acid anhydrides, acid chlorides, cellulose nitrate, isocyanates, nitrous acid, nitrites, copper, copper alloys, zinc, galvanized iron and galvanized steel. May react with carbon dioxide in the air to form salts.

IDENTIFICATION

Shipping Name(s): 2-Dimethylaminoethanol (USDOT & IMO)
Synonyms and Tradenames: Dimethylaminoethanol; DMAE; beta-Dimethylaminoethyl alcohol; Dimethylethanolamine; beta-hydroxyethyldimethylamine; Deanol; N,N-Dimethyl-2-Hydroxyethylamine; N,N-Dimethylaminoethanol; N,N-Dimethylethanolamine; N,N-dimethyl-N-(2-hydroxyethyl)amine; N,N-Dimethyl-N-ethanolamine
CAS Registry No.: 108-01-0
Chemical Formula: $HOCH_2CH_2N(CH_3)_2$
Constituent Components (% each): Typically 70 - 100%
UN/NA Designation: UN2051
IMO Designation: 8, Corrosive substances
RTECS Number: KK6125000
NFPA 704 Hazard Rating: 2 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless to pale yellow liquid
Odor Characteristics: Pungent, amine-like odor
Common Uses: It is used as a medication in the treatment of behavioral problems in children. It is also used in making dyestuffs, textiles, pharmaceuticals and emulsifiers in paints and coatings.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

2-DIMETHYLAMINOETHANOL

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.015 ppm - 0.25 ppm

Unusual Hazards: Highly corrosive. Product is a hygroscopic and flammable liquid.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, fire or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Vapors are extremely corrosive to the eyes, brief contact will be extremely irritating and can cause permanent damage including blindness.

Hazards of Inhalation: Breathing vapors can irritate the nose, throat and lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema). Can cause headache, muscle tenderness, restlessness, increased irritability, lack of sleep, weight loss and possibly death.

Hazards of Ingestion: Ingestion may result in severe burns of the mouth, throat, pharynx and gastrointestinal tract. May cause nausea, vomiting drowsiness, dizziness, incoordination, unconsciousness and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 1.9%

Upper Flammable Limit: 13.4%

Behavior in Fire: Product is flammable. May generate large quantities of corrosive fumes or vapors upon release.

Hazardous Combustion Products: Products of combustion include carbon monoxide, carbon dioxide and nitrogen oxide.

EXPLOSION HAZARDS

Explosive Potential: Contact with oxidizers may result in fire or explosion. Product is sensitive to static discharge.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

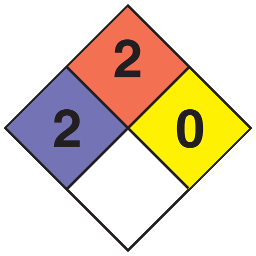
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Butyl rubber and nitrile rubber are reported to have a resistance to breakthrough longer than 8 hours. 4H^{TM} is reported to have a resistance to breakthrough longer than 4 hours. Natural rubber, neoprene, polyvinyl chloride and Viton$^{®}$ are NOT RECOMMENDED for use as they have a reported resistance to breakthrough of less than 1 hour.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted acid gas canister and high efficiency particulate filter or a high efficiency particulate filter respirator with a full facepiece.

2051

2-DIMETHYLAMINOETHANOL

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Eye Contact: Flush eyes immediately with water for at least 30 minutes, while lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide or alcohol-resistant foam.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire-exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Product is a highly corrosive, flammable liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that product is highly corrosive and reactive. Use explosion-proof and spark-proof equipment where necessary. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . 2-Dimethylaminoethanol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the product is not fuming or small quantities have spilled.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

2-DIMETHYLAMINOETHANOL
Class 8 (Corrosive Material)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to corrosive and/or toxic concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of chemical from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Alcohol-resistant foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . 2-Dimethylaminoethanol may be confined by building dikes using soil, dry sand or other materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible, impervious materials.

2-DIMETHYLAMINOETHANOL

Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, noncombustible compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

2-DIMETHYLAMINOETHANOL

Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

DIMETHYLDICHLOROSILANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Dimethyldichlorosilane is a clear, colorless, flammable, fuming liquid with a pungent, sharp, irritating odor resembling hydrogen chloride or muriatic acid, commonly used as an intermediate for the manufacture of silicone products. Its flash point of approximately 3°F indicates that the product is easily ignited under most ambient temperature conditions. Vapors are somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time, duration. The liquid weighs approximately 8.9 pounds per gallon.

Dimethyldichlorosilane reacts vigorously or violently with water to form hydrochloric acid and a complex mixture of dimethylsiloxanes (which are presumed to be oily silicone fluids of low solubility) in a process that may evolve corrosive and toxic fumes. It is also incompatible with oxidizing agents, solvents containing hydroxyl, and possibly a wide variety of other substances, and is highly irritating and corrosive to bodily tissues by all routes of exposure. Products of combustion include hydrochloric acid, hydrogen chloride, possibly phosgene, and other possibly toxic constituents.

If dimethyldichlorosilane is leaking but not on fire and generating vapors or fumes, downwind evacuation should be considered. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts vigorously
Solubility in Other Chemicals: Soluble in benzene and ether
Specific Gravity (Liquid): 1.06 at 68°F (20°C)
Boiling Point: 158.0–158.9°F (70–70.5°C) at 1 atm
Melting Point: Either –122.8°F (–86°C) or –104.8°F (–76°C); reported values vary.
Freezing Point: See melting point
Molecular Weight: 129.06
Heat of Combustion: Est. –3300 cal/g
Vapor Pressure: *100* mm Hg (1.933 psia) at 63.5°F (17.5°C)
Flash Point: 3.2°F (–16°C),closed cup; 15–16°F (–9.4 to –8.9°C),open cup
Autoignition Temperature: Over 750°F (399°C)
Burning Rate: 3.3 mm/minute
Stability: Stable during normal transport
Corrosiveness: Steel is satisfactory for dry dimethyldichlorosilane, but any contact with water or moisture produces hydrochloric acid that is corrosive to most metals.
Reactivity with Water: Reacts vigorously with water to form hydrochloric acid and complex mixture of dimethylsiloxanes. Corrosive and toxic fumes may be evolved.
Reactivity with Other Chemicals: Reacts with oxidizing agents, solvents containing hydroxyl, and possibly a wide variety of other substances.

IDENTIFICATION

Shipping Names: Dimethyldichlorosilane (USDOT and IMO)
Synonyms and Tradenames: Dichlorodimethylsilane; dichlorodimethylsilicon; Inerton DW-DMC.
Chemical Formula: $(CH_3)ZSiCl_2$
Constituent Components (% each): 99% or more pure
49 STCC: 4907610
UN/NA Designation: UN1162
IMO Designation: 3.2, flammable liquid
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless, clear, fuming liquid
Odor Characteristics: Pungent, sharp, acidic, irritating, like hydrogen chloride or muriatic acid.
Common Uses: Intermediate for silicone products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DIMETHYLDICHLOROSILANE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** Unavailable

Unusual Hazards: Highly flammable and moderately volatile fuming liquid that reacts vigorously or violently with water or moisture to form highly corrosive hydrochloric acid and dimethylsiloxanes.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure. May be present in air in high concentrations in spill area and over considerable downwind distances.

Hazards of Skin or Eye Contact: Liquid dimethyldichlorosilane may cause severe burns in contact with the skin or eyes, with eye effects including severe pain, swelling, corneal erosion, and possibly permanent injury and/or loss of sight. Concentrated vapors or fumes in air may also cause significant irritation.

Hazards of Inhalation: Vapors and fumes of dimethyldichlorosilane are highly irritating to the eyes and respiratory tract. Excessive exposures may result in difficulty in breathing, nausea, vomiting, rapid heartbeat, shock, pulmonary edema, suffocation, and possibly death. Some symptoms may be delayed in onset. Exposure to 930 ppm for 4 hours was sufficient to cause fatalities among rats in laboratory experiments.

Hazards of Ingestion: Ingestion of dimethyldichlorosilane may cause severe burns of the mouth and stomach and may prove fatal.

Edema of the throat may close the airway.

FIRE HAZARDS

Lower Flammable Limit: 3.4%

Upper Flammable Limit: 9.5% (possibly greater)

Behavior in Fire: Flammable liquid. Difficult to extinguish. May generate large quantities of flammable vapor upon release. Vapors may travel to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Hydrochloric acid, hydrogen chloride, possibly phosgene, and other possibly toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Reaction with water produces hydrochloric acid that may evolve flammable and potentially explosive hydrogen gas in contact with most metals.

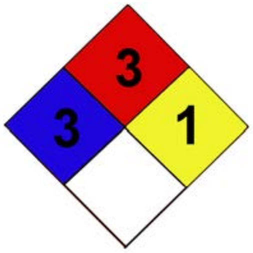
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid gas canister or an acid gas cartridge respirator with a full facepiece within the use limitations of these devices.

1162

DIMETHYLDICHLOROSILANE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol foam, water fog or spray. Note that the spilled product reacts with water such that water or foam must be applied with caution.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. *Staff upwind*. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Use explosion-proof and spark-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the reactive, flammable, and potentially corrosive nature of dichlorodimethylsilane into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent public exposure and to allow vapors or fumes to dissipate. Dimethyldichlorosilane spills may expose downwind areas to toxic and/or flammable concentrations over considerable distances.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

DIMETHYLDICHLOROSILANE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to dimethyldichlorosilane vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain dimethyldichlorosilane from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FLOODING WITH WATER . . . The rapid addition of flooding quantities of water to liquid dimethyldichlorosilane may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION . . . There is a possibility that the application of an appropriate neutralization agent to liquid dimethyldichlorosilane may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that application of alcohol foam to the surface of liquid pools may slow the release of dimethyldichlorosilane fumes or vapors into the atmosphere. (Note: Several sources suggest foam use for firefighting even though the water in the foam will clearly react with the spilled product. Thus, there is a chance the foam may control fume evolution if a blanket of foam can be maintained.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid dimethyldichlorosilane may be contained by building dikes using dry sand or other compatible dry materials.

CONSEQUENCE

Contained liquid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

DIMETHYLDICHLOROSILANE

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid, with dry sand, dry vermiculite, dry ground dolomite, or possibly other noncombustible mineral-based materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE .

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Motorized equipment may ignite flammable vapors in the spill area.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product. Store contaminated materials in a safe and secure location. Take suitable precautions for the possibility of flammable vapor concentrations in the spill area.

DIMETHYLDICHLOROSILANE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Dimethyldichlorosilane reacts vigorously with water to form hydrochloric acid and a complex mixture of dimethylsiloxanes. Water containing chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land. (Note: Other containment or treatment methods may be necessary for any dimethylsiloxanes in the water. Data on this topic were unavailable. Contact shippers or other sources of expert advice for assistance where necessary.)

September 2003

DIMETHYL ETHER

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Dimethyl ether, also commonly known as methyl ether, is a colorless gas or liquid (liquefied compressed gas) having a slight ethereal odor. It is used as a refrigerant, solvent, propellant for aerosol sprays and in making certain plastics. It is stable, although any source of ignition should be avoided. Containers that have been opened and then stored for six months or longer can form peroxides which can then be detonated by friction, impact or heating. It is soluble in water, alcohol, ether, chloroform, acetone and organic solvents. Incompatible materials include, but are not limited to, strong oxidizing agents, combustible materials and halogens (see below). The primary route of entry is inhalation of the vapors. Dimethyl ether has no toxicity reported except that it may asphyxiate and cause frost-like burns of the skin or eyes from contact with liquid. Inhalation in moderate amounts may cause headaches, drowsiness and dizziness. Larger amounts may cause unconsciousness and death due to asphyxia.

The flammability potential for dimethyl ether is high. It will readily ignite from any source of ignition, including static electricity and friction from escaping gas. Flammable mixtures are formed in air. Vapors are heavier than air, may travel to distant sources of ignition and flash back. Initial downwind evacuation should be considered for at least one-half (1/2) mile if product is leaking but not on fire. If container of dimethyl ether is exposed to direct flame or a fire becomes uncontrollable, evacuate for one (1) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble (7.6%)
Solubility in Other Chemicals: Soluble in alcohol, ether, chloroform, acetone and organic solvents.
Specific Gravity: 0.661
Vapor Density (Air=1): 1.62
Boiling Point: -11°F (-24°C)
Melting Point: -224°F (-142°C)
Freezing Point: See melting point
Molecular Weight: 46.07
Heat of Combustion: -1328.3 kJ/mol
Vapor Pressure: 3,982 mm Hg at 68°F (20°C)
Flash Point: -42°F (-41°C) c.c.
Autoignition Temperature: 662°F (350°C)
Burning Rate: Unavailable
Flammable Limits: 3.4% (LEL) - 27% (UEL)
Stability: Stable. Avoid sparks or flame source that can cause ignition.
Polymerization Potential: Will not occur
Corrosiveness: Non-corrosive and can be used with most common structural metals.
Reactivity and Incompatibility: May form explosive peroxides. Avoid prolonged storage, contact with air, light or use above room temperature. Incompatible with oxidizing materials, combustible materials and halogens. Contact with chromic anhydride, nitric acid, oxidizers, oxygen and ozone may cause explosion. Aluminum hydride and lithium tetrahydroaluminate may cause explosion due to carbon dioxide impurity.

IDENTIFICATION

Shipping Name(s): Dimethyl Ether (USDOT & IMO)
Synonyms and Tradenames: Dimethyl-13C2 ether (gas); Methoxymethane; Methyl ether; Methyl oxide; Oxybismethane; Wood ether
CAS Registry No: 115-10-6
Chemical Formula: C_2H_6O
Constituent Components (% each): 100%
UN/NA Designation: UN1033
IMO Designation: 2.1, Flammable gases
RTECS Number: PM4780000
NFPA 704 Hazard Rating (Gas): 1 (Health): 4 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Compressed gas or liquid
Physical Form as Released: Gas or liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Ethereal odor
Common Uses: It is used as a refrigerant, solvent, propellant for aerosol sprays and in making certain plastics.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

DIMETHYL ETHER
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly flammable. Liquid form of dimethyl ether can cause frost-like burns. Inhalation of large concentration of gas may cause dizziness, drowsiness and unconsciousness. Peroxides may form in containers that have been opened and then stored for six months or longer. Peroxides can be detonated by friction, impact or heating.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity and incompatible materials.

HEALTH HAZARDS

Potential Health Hazards: Dimethyl ether has no toxicity reported except that it may asphyxiate and cause frost-like burns with skin or eye contact.

Hazards of Skin or Eye Contact: Eye or skin contact with liquid can cause frostbite type injury due to rapid cooling from evaporation.

Hazards of Inhalation: Narcotic or anesthetic effects depend on the duration of exposure and vary from incoordination, headache, dizziness, periods of excitation, inability to see well, to anesthesia and eventual unconsciousness.

Hazards of Ingestion: Ingestion is unlikely due to physical properties of dimethyl ether. Contact with the extremely cold liquid would, at the very least, cause frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 3.4%

Upper Flammable Limit: 27%

Behavior in Fire: Flammable gas. It will readily ignite if exposed to sources of heat and flame. Vapors may be heavier than air, travel along the ground and settle in low lying areas to form explosive mixtures with air. Vapors may travel to a distant source of ignition and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity and other potential ignition sources at locations distant from the point of release. Containers exposed to prolonged fire or heat may violently rupture.

Hazardous Decomposition Products: Products of combustion may include carbon monoxide, carbon dioxide and irritating and toxic fumes.

EXPLOSION HAZARDS

Explosive Potential: High. Severe explosion hazard when exposed to heat, flame or oxidizers. Explosive when mixed with air. Escaping gas may ignite spontaneously due to friction. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged fire or heat may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

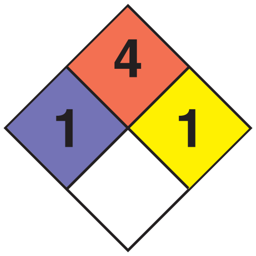
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Buna N (R) rubber is recommended by one source as exhibiting reasonable resistance. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1033

DIMETHYL ETHER

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Contact of liquid with skin or eyes may cause frost-like burns. Inhalation is the major route of exposure and can cause headache, drowsiness, dizziness and unconsciousness.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact with cold liquid, remove contaminated clothing and wash affected body areas with large amounts of warm water. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming such as wrapping effected area gently in blankets if warm water is not available. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Ingestion is unlikely. If liquid is ingested, frostbite-like injury can occur. Drink warm water to relieve frostbite, but do not induce vomiting without medical supervision. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

FIRE RESPONSE

Extinguishing Agents: Stop flow. Carbon dioxide, dry chemical or water spray (fog). A fine water spray or fog can be used on large discharges to control the fire by preventing its spread and absorbing some of its heat.

Extinguishing Techniques: Stay upwind. Secure ignition sources in the immediate spill area and downwind. Approach fire from upwind to avoid flammable vapors. Wear positive-pressure, self-contained breathing apparatus and appropriate protective clothing. Wear full chemical and/or thermal protective suit as necessary and appropriate. Move container from fire area if no risk. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to prolonged heat, such as from a direct flame. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable gases.

DIMETHYL ETHER
Division 2.1 (Flammable Gas)

SPILL RESPONSES

General Information: Dimethyl ether is highly flammable. Eliminate all sources of ignition. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with very cold gas or liquid unless properly equipped for such contact. If transfer operations are anticipated, only use equipment specifically designed for use with the material being transferred and its temperature and pressure at the time of transfer. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows and depressions. Use combustible gas detectors prior to entering any potentially affected confined space or any low area in which cold, heavier-than-air gases or vapors may have accumulated. Do not direct water at a venting safety device since this may cause icing to occur. Note that the rapid escape of gas under pressure may generate a static electricity charge that could cause gas ignition. Be advised that the very low temperatures associated with dimethyl ether can cause many materials to become brittle and subject to sudden failure or cracking. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ mile in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

DIMETHYL ETHER
Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to the soil, liquid will initially boil rapidly, generate a large amount of flammable vapors and freeze the ground it is in contact with. Much later, the liquid will reach a less rapid boiling rate thereby evolving less vapors. Containment dikes or barriers using soil, dry sand or other related, non-combustible materials may be effective to confine the spill to a limited area thereby reducing the surface area and volume of gas generated until liquid evaporates. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material.

CONSEQUENCE

Contained material will take longer to evaporate.

MITIGATION

Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater, which may overfill diked areas.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches. Reducing the spill surface area may decrease vapor generation.

CONSEQUENCE

Contained material will take longer to evaporate. Mechanical equipment could ignite material.

MITIGATION

Continually monitor for flammable conditions. Dig a deep pit with small area to reduce vapor generation rate. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill pits.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Due to its relatively low boiling point, high pressures may develop very rapidly in recovery equipment at moderate to high ambient temperatures.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as carbon dioxide or nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates when equipment temperatures exceed the boiling point of the liquid to be recovered. Consult qualified experts as necessary for assistance.

TECHNIQUE

MECHANICAL REMOVAL . . . Most if not all the product will rapidly vaporize from soil surfaces once the bulk of the liquid has vaporized. Mechanical equipment can be used to grade frozen ground to eliminate any pockets of material.

CONSEQUENCE

Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Continually monitor for flammable conditions.

DIMETHYL ETHER

Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake and monitor situation.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where emissions may pose a downwind hazard.

August 1996

N,N-DIMETHYLFORMAMIDE*

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

N,N-Dimethylformamide is a colorless to pale yellow liquid with a fish/ammonia-like odor used as a solvent for liquids, gases, orlon and similar polyacrylic fibers. It is also reacted with chlorosulfonic acid to produce cellulose sulfate, an anti-static agent, photographic film additive, and solution thickener. In addition, N,N-dimethylformamide is termed the universal organic solvent and is used as a selective medium for extraction of aromatics from crude oil, solvent for dyes, as a solvent for the formation of acrylic fibers and sheets, films, and coatings of other polymeric materials such as polyurethanes and specialty PVC. In the pharmaceutical industry, the product is used as a crystallization medium for the purification of vitamins and hormones. N,N-dimethylformamide has commercial use as a solvent for electrolytes, particularly in high voltage capacitors and in electroplating processes. N,N-dimethylformamide is produced from the reaction of methyl formate and dimethylamine, or from dimethylamine and formic acid. Other manufacturing processes include the reaction of carbon monoxide and dimethylamine, and the reaction of hydrogen cyanide and methanol. N,N-dimethylformamide is harmful if inhaled or on skin contact. It may be toxic if inhaled or absorbed through the skin for prolonged periods. The most common routes of exposure are through inhalation and skin contact. It is a strong skin irritant. **N,N-dimethylformamide is a potential human carcinogen** (Group 2B).

Although the fire potential for N,N-dimethylformamide is moderate, heating can release ignitable vapors, which can form explosive mixtures with air. The material is generally stable, however it may react vigorously with oxidizing agents and halogenated hydrocarbons. Vapors are heavier than air and may settle in low lying areas. Vapors may travel considerable distances to an ignition source and flash back. Normal structural fire fighting protective clothing will not provide an adequate level of personal protection for working in contaminated atmospheres. Runoff may be flammable and/or toxic. N,N-dimethylformamide is miscible with water and most organic solvents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble.
Solubility in Other Chemicals: Alcohol, ether acetone, benzene, and chloroform.
Specific Gravity (Liquid): 0.95 @ 25°C (77°F)
Vapor Density (Air=1): 2.5
Boiling Point: 153°C (307°F)
Melting Point: -47°C (-52°F)
Freezing Point: -61°C (-78°F).
Molecular Weight: 73.10
Heat of Combustion: Unavailable.
Evaporation Rate: Unavailable.
pH: 6.7
Vapor Pressure: 3.7 mm Hg at 20°C (68°F)
Flash Point: 58°C (136°F)
Autoignition Temperature: 445°C (833°F)
Flammable Limits: 2.2% (LEL) - 15.2% (UEL)
Stability: Stable
Polymerization Potential: Will not occur except in those situations where the material comes in contact with diisocyanatomethane which causes violent polymerization of the isocyanate.
Reactivity and Incompatibility: Can react vigorously with oxidizing agents, halogenated hydrocarbons and inorganic nitrates. Incompatible with carbon tetrachloride, aluminum alkyls, bromine, inorganic acids, magnesium, and isocyanates.
Other Characteristics: Can generate hazardous fumes when exposed to heat and flames. Material is a dipolar aprotic solvent.

IDENTIFICATION

Shipping Name(s): N,N-Dimethylformamide (USDOT & IMO)
Synonyms and Tradenames: Dimethyl Formamide, DMF, DMF (Amide), DMFA, Formamide, N,N-Dimethyl, Formic Acid, Amide, N,N-Dimethyl, N,N-Dimethylmethanamide, N-Formyldimethylamine, NSC 5256, U-4224, NCI-C60913. CAS Registry No: 68-12-2
Chemical Formula: C_3H_7NO
Molecular Formula: C_3H_7NO
UN/NA Designation: UN2265
IMO Designation: 3.3
RTECS Number: NIOSH/LQ2100000
OHMTADS Number: Unavailable.
NFPA 704 Hazard Rating: 1 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless to pale yellow
Odor Characteristics: Fish/Ammonia-like odor
Common Uses: N,N-Dimethylformamide is considered a universal organic solvent and is used as a selective medium for extraction of aromatics from crude oil, solvent for dyes, as a solvent for the formation of acrylic fibers and sheets, films, and coatings of other polymeric materials such as polyurethanes and specialty PVC.

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*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

N,N-DIMETHYLFORMAMIDE

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 100 ppm

Unusual Hazards: Strong skin irritant and possibly carcinogenic to humans.

Time Weighted Average (TLV-TWA): 10 ppm.

Short Term Exposure Limit (STEL): Unavailable.

IDLH: 3500 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as oxidizing agents, halogenated hydrocarbons, inorganic nitrates, contact with carbon tetrachloride, triethylaluminum, sodium metal, and aluminum alkyls.

HEALTH HAZARDS

Potential Health Effects: N,N-dimethylformamide is a strong skin irritant. Contact with the eyes and skin may result in irritation. It may be poisonous if inhaled or absorbed through the skin. Vapors may cause dizziness or suffocation. Material is considered moderately hazardous by inhalation and may pass through intact skin or can be absorbed through the lungs. Inhalation may cause facial flushing, mucous membrane irritation, cyanosis, headache, dizziness, confusion, and coma. Excessive exposures may cause adverse reactions of the liver, kidneys, skin and cardiovascular system. N,N-dimethylformamide is a possible human carcinogen. Individuals with pre-existing conditions of the central nervous system or lungs may have increased susceptibility to the toxicity of excessive exposures.

Hazards of Skin Contact: Skin contact may cause skin irritation with rash, redness, and swelling. Prolonged exposures may lead to skin burns, blistering and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, swelling, tearing, chemical conjunctivitis, corneal burns, opacification, or blurred vision. Profuse lacrimation may also occur in some cases.

Inhalation Hazards: Inhalation may cause irritation to the upper respiratory passages, and mucous membranes, pulmonary edema, wheezing, and dyspnea. Prolonged exposures can produce central nervous system (CNS) effects such as cyanosis, nausea, headache, dizziness, confusion, and coma.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, vomiting and abdominal pain.

FIRE HAZARDS

Lower Flammable Limit: 2.2%

Upper Flammable Limit: 15.2%

Behavior in Fire: Although it will not readily ignite, N,N-dimethylformamide will burn if exposed to sources of heat and flame. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic.

Hazardous Decomposition Products: When heated to decomposition, material releases gases such as carbon monoxide and oxides of nitrogen.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. A mixture of trimethylaluminum and N,N-dimethylformamide explodes when heated.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

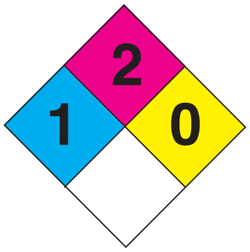
Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are butyl rubber and teflon. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited.

2265

N,N-DIMETHYLFORMAMIDE

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Skin contact with the liquid may cause redness, swelling, burning, and dermatitis. Excessive exposures may cause temporary central nervous system depression with anesthetic effects such as , dizziness, drowsiness, nausea, headache, confusion, and loss of consciousness. Prolonged eye contact may result in reversible corneal injury. Inhalation may cause irritation to the upper respiratory passages and mucous membranes with coughing and discomfort.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog), or alcohol-based foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be flammable and/or toxic.

SPILL RESPONSES

General Information: N,N-dimethylformamide may cause environmental contamination. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways, and storm drains. Underflow dams are not an effective means to dike material since it readily mixes with water. As a result, recovery efforts from water borne releases are difficult. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

N,N-DIMETHYLFORMAMIDE

Class 3 (Flammable Liquid) or Combustible Liquid

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential ignition sources such as of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...Based on its vapor pressure, N,N-dimethylformamide is expected to exist almost entirely in the gaseous phase when released into the atmosphere. The highest concentrations of material will usually be located at ground level. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if hazardous concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

FOAM...Alcohol-resistant foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

N,N-DIMETHYLFORMAMIDE

Class 3 (Flammable Liquid) or Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...The biodegradation of N,N-dimethylformamide in water sources should be rapid. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material readily mixes with water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms are not an effective means to recover spilled material since the material is water soluble. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material is water soluble and the material does not float on the surface of the water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

N,N-DIMETHYLFORMAMIDE

Class 3 (Flammable Liquid) or Combustible Liquid

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...N,N-dimethylformamode is estimated to be highly mobile in soil. The material is readily biodegradable, and therefore, would be expected to biodegrade rapidly in soil. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed, or confine or divert the spill to a limited area until the material volatizes or biodegradation occurs.

CONSEQUENCE

Material is highly mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

October 1993

DIMETHYL SULFATE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Dimethyl sulfate is a colorless, oily, combustible, and highly poisonous liquid that may be odorless or have a faint odor like onion. It is heavier than water and somewhat soluble, so may be expected to sink to the bottom of a body of water and dissolve at a fairly appreciable rate. Its lowest reported flash point of 182°F (83.3°C) indicates that it must be preheated before it can be easily ignited. Accumulations of vapors may explode if ignited in confined spaces such as buildings or sewers. The product weighs approximately 11.1 pounds per gallon. Be advised that many but not all data sources indicate that the autoignition temperature of the substance is only 370°F (187.8°C).

Dimethyl sulfate is stable in normal transportation. It reacts with moisture or water to form methyl hydrogen sulfate which further decomposes to sulfuric acid and methyl alcohol in a non-hazardous fashion. It will attack some forms of plastics, rubber and coatings. Although the vapor pressure of dimethyl sulfate is quite low at normal ambient temperatures, the toxic hazard posed by the liquid and its vapors is extremely high. Not only are effects severe and delayed in onset, but a lack of warning properties means that the victim is usually not aware a serious and potentially lethal exposure is taking place. Products of combustion are not well-defined but may include irritating, corrosive, and/or toxic substances such as sulfuric acid, methyl alcohol, carbon monoxide, carbon dioxide, sulfur dioxide, sulfur trioxide, and possibly other harmful substances.

Downwind evacuation or an alternative protective action must be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if dimethyl sulfate is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Fairly soluble.

Solubility in Other Chemicals: Soluble in alcohol, aliphatic hydrocarbons, carbon disulfide, and ether.

Specific Gravity (Liquid): 1.33 at 68°F (20°C)

Boiling Point: 370.4°F (188°C) with decomposition at 1 atm.

Melting Point: -16.2°F (-26.8°C) to -25.2°F (-31.8°C); reported values vary.

Freezing Point: See melting point.

Molecular Weight: 126.13.

Heat of Combustion: Not available.

Vapor Pressure: 0.1 mm Hg (0.00193 psia) at 70°F (21.1°C); and 1.1 mm Hg (0.02126 psia) at 100°F (37.8°C).

Flash Point: 182°F (83.3°C), closed-cup; 182°F (83.3°C) or 240°F (115.6°C), open-cup.

Autoignition Temperature: Most sources 370°F (187.8°C) a major producer 923°F (495°C).

Burning Rate: Not available.

Stability: Stable.

Corrosiveness: Corrodes various metals in the presence of water or moisture due to the formation of sulfuric acid; will attack some forms of plastics, rubber, and coatings.

Reactivity with Water: Reacts in a non-hazardous fashion with water or moisture to form methyl hydrogen sulfate which further decomposes to corrosive sulfuric acid and potentially flammable and toxic methyl alcohol while evolving heat (and pressure in closed containers). Any heat evolved in reactions with water or chemicals may increase the vaporization rate of dimethyl sulfate.

Reactivity with Other Chemicals: Available data are limited. Mixture with sodium azide may explode if its pH is allowed to fall below 5; reacts extremely violently with anhydrous ammonia or concentrated aqueous ammonia; ignites in contact with barium chlorite; is incompatible with strong oxidizers, strong caustic solutions, and a broad range of other substances according to various authorities.

IDENTIFICATION

Shipping Names: Dimethyl sulfate.

Synonyms and Tradenames: Acid, sulfuric dimethyl ester; methyl sulfate; dimethyl monosulfate; DMS; and sulfuric acid, dimethyl ester.

Chemical Formula: $(CH_3)_2S0_4$

Constituent Components (% each): Limited data available. One major maker describes its product as 100% pure.

UN/NA Designation: UN1595.

IMO Designation: 6.1, poisonous material.

Physical State As Shipped: Liquid.

Physical State As Released: Liquid.

Color of the Shipped Material: Colorless oily liquid.

Odor Characteristics: Odorless or with a weak, faint odor like onion according to most sources.

Common Uses: Used to make many organic chemicals, polyurethane-based adhesives, dyes, pharmaceuticals, perfumes, pesticides, and solvent.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

DIMETHYL SULFATE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Only value found was 0.1 ppm.

Unusual Hazards: Extremely toxic substance with unusual characteristics. Many but not all authorities list an autoignition temperature of only 370°F (187.8°C).

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: (Skin) 0.1 ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989). ACGIH considers this substance to be a suspected human carcinogen.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Both liquid dimethyl sulfate and its vapors are extremely corrosive and toxic with severe effects that often do not become apparent for several hours after exposures have ended. This material is a suspected, mutagen, carcinogen and teratogen when subjects are exposed to long-term inhalation of vapors or repeated injection of liquid under the skin. Repeated exposures may result in loss of hair. All exposures should be strictly avoided.

Hazards of Skin or Eye Contact: Low levels of vapors in air may cause numbness such that the extremely corrosive action of the substance may not be detected while an exposure is occurring. Exposure of the eyes to vapors, after a period of up to 6 hours without symptoms, can result in severe irritation and inflammation, sensitivity to light, lacrimation, swollen eyelids, conjunctival hyperemia, superficial clouding and irregularity of surface tissues of the cornea, and possibly tissue death. The skin of the face and other exposed parts may become red and there may be a temporary loss of smell and taste. Contact of the liquid with the eyes may cause no immediate discomfort but be followed later by sudden pain, swelling of the lids and anterior chambers of the eyes, gray-white opacification of the cornea, tissue destruction, and corneal or conjunctival ulceration resulting in permanent loss of vision. Effects of skin contact with the liquid may also be delayed for several hours without signs of discomfort. Symptoms are said to start with a burning and itching sensation and redness, followed by severe blistering, tissue burns, ulceration, and eventual scarring of the affected area. Absorption of the liquid through skin is rapid and may result in poisoning at times even if the skin is promptly treated. Such poisoning may result in various symptoms associated with inhalation exposures, convulsions, delirium, coma, and even death in severe cases. Unprotected contact with the vapor or with the liquid requires immediate medical attention even if there is no evidence of injury. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Except for the possibility of slight eye and nose irritation, the vapors of dimethyl sulfate provide no warning that extremely hazardous exposures are taking place. Symptoms of exposure may be delayed in onset for up to 10 hours and may variably include temporary loss of smell and taste, generalized loss of sensitivity to pain, nausea, vomiting, diarrhea, giddiness, delirium, fever, headache, weakness, irregular pulse, fall in arterial pressure, pain and swelling of the larynx causing hoarseness, difficulty in swallowing, chest pain, severe inflammation and death of tissues of the mouth and respiratory tract, difficult breathing, painful coughing, foamy white sputum, painful urination, cyanosis, prostration, convulsions, paralysis, severe lung damage with effects including emphysema, bronchitis and pulmonary edema, coma, delayed damage to the kidneys, liver and heart, and death (either prompt or delayed). Prolonged exposures may cause liver and kidney injury leading to yellow jaundice and bloody urine. Repeated excessive exposures over a period of time may cause changes to the lymph nodes, inflammation and tumors of the nasal cavity, lung and brain tumors, pneumonia, and possibly death. The concentration of dimethyl sulfate vapors directly over a pool of the liquid is at least 130 ppm and possibly as high as 660 ppm at 68 - 70°F (20 - 21.1°C); about 920 ppm at 77°F (25°C); and about 1450 ppm at 100°F (37.8°C). The lowest concentration reported fatal to a human is 97 ppm in a 10 minute exposure. The NIOSH (1990) IDLH for dimethyl sulfate is 10 ppm.

Hazards of Ingestion: Ingestion of liquid dimethyl sulfate, in addition to effects associated with inhalation, may cause burns of the mouth, throat, and stomach. In one actual case, symptoms first appeared after half an hour and led to death due to cardiac failure within three hours. Dosages that result in the death of 50% of rats and mice are in the range of 140 to 440 mg/kg.

FIRE HAZARDS

Lower Flammable Limit: 3.6%.

Upper Flammable Limit: 23.3%.

Behavior in Fire: Combustible liquid. Requires preheating to be easily ignited. May generate flammable vapors upon release if heated above its flash point. Such vapors may travel to a source of ignition and flash back. Containers may possibly rupture or explode in a fire. If not ignited, liquid dimethyl sulfate may vaporize at a higher rate upon heating and pose greater downwind inhalation hazards.

Hazardous Combustion Products: Not well-defined; reported to include toxic and/or corrosive vapors and fumes containing sulfuric acid, methyl alcohol, carbon monoxide, carbon dioxide, oxides of sulfur, and possibly other harmful substances.

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors from hot liquid are ignited in a confined area. Containers may possibly rupture or explode in a fire. Contact or mixture with certain other chemicals may result in an explosion.

1595

DIMETHYL SULFATE
Division 6.1 (Poisonous Material)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing in well-controlled normal operations. Under fire or non-fire spill conditions, fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with vapors and/or combustion products. Compatible materials for dimethyl sulfate itself, according to a major maker of the product, may include butyl rubber and neoprene. Another source recommends polyethylene/ethylene vinyl alcohol/polyethylene (PE/EVAL/PE) material. NIOSH notes that use of fully encapsulating suits may be necessary to prevent skin contact at levels in air greater than 10 ppm. Another authority implies protection is needed even at 1 ppm. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: At concentrations above 0.1 ppm, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; nausea, vomiting, diarrhea, giddiness, fever, headache, weakness, respiratory system discomfort, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. (Note: A physician should be contacted immediately if anyone develops any possible symptoms of a chemical exposure and suspects they may have been caused by exposure to dimethyl sulfate.)

First Aid for Skin and Eye Contact: Unprotected contact with the vapor at levels over 1 ppm or with the liquid product requires immediate treatment even if there is no evidence of injury. Flush eyes immediately with water for at least 15 minutes occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get immediate medical attention.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective but very large quantities may dilute the spill to a nonflammable mixture.

Extinguishing Techniques: Unusual toxic/corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material, its vapors, or combustion products is anticipated. Move container from fire area if no risk. Do not get water inside container. Be alert to the possibility that a closed container may possibly rupture or explode and suddenly release massive amounts of product if exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with extreme caution. Restrict access to area. Keep all unprotected personnel upwind and away from spill area. Avoid any and all contact with spilled product and its vapors. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product or its products of reaction with moisture or water where these may be present. Ground all equipment and transfer lines as necessary prior to use. Remember that products of reaction of dimethyl sulfate with moisture or water include corrosive sulfuric acid and potentially flammable methyl alcohol. Take the toxic nature and unusual hazards of dimethyl sulfate into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Dimethyl sulfate discharges may expose downwind areas to highly toxic concentrations over very considerable distances in some cases.

DIMETHYL SULFATE
Division 6.1 (Poisonous Material)

AIR SPILL *(CONTINUED)*

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to dimethyl sulfate vapors in air may absorb them and/or accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not let spray contact pools of liquid dimethyl sulfate if one or more of the following response techniques is not also employed simultaneously (since the reaction of dimethyl sulfate with small amounts of water spray may possibly generate heat that may promote increased vaporization of the liquid).

CONSEQUENCE

Water runoff may contain varying amounts of dimethyl sulfate and its products of reaction with water.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of dimethyl sulfate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Proceed with extreme caution. Consult qualified experts for advice where necessary. Maintain a foam blanket that is as thick as possible. Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . Dimethyl sulfate is heavier than water and of limited solubility. Gentle application of water spray onto the surface of confined liquid pools may possibly form a floating layer of water that reduces vapor emissions. Remember that dimethyl sulfate will react with water. Progressive addition of water to liquid dimethyl sulfate will eventually cause its conversion to sulfuric acid and methyl alcohol. Note also that this approach may possibly be combined with neutralization techniques discussed below.

CONSEQUENCE

Addition of water will increase the volume of contained liquids.

MITIGATION

Proceed with extreme caution. Consult qualified experts for advice where necessary. Contain liquids and neutralize and/or remove them as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid dimethyl sulfate may eventually slow the release of vapors into the atmosphere by modifying the spilled product to less hazardous substances. (Note: A manufacturer indicates that liquid dimethyl sulfate can be treated with dry soda ash followed by water flooding, a 2 - 5% solution of aqueous ammonia, or a dilute caustic soda solution. The resulting liquid mixture should be allowed to stand until it tests negative for the presence of dimethyl sulfate. Depending on environmental concerns, the resulting mixture should be removed or the spill area should be flushed with plenty of water.)

CONSEQUENCE

Application of chemical agents may entail additional risks.

MITIGATION

Proceed with extreme caution. Consult qualified experts for safe neutralizing techniques and more specific advice.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquids may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in spread of contamination.

DIMETHYL SULFATE
Division 6.1 (Poisonous Material)

AIR SPILL *(CONTINUED)*

MITIGATION

Neutralize and/or remove contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Neutralize and/or remove liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Any moisture or water present will react with dimethyl sulfate to form flammable methyl alcohol and corrosive sulfuric acid.

MITIGATION

Use dry equipment compatible with the spilled product (and its reaction products with moisture or water if and as necessary).

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to less hazardous substances. See the discussion on neutralization under the heading "Air Spill" above.

CONSEQUENCE

Application and removal of chemical agents may entail additional risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors present in the area may be ignited by motorized removal equipment under appropriate circumstances. (Note: Potentially flammable methyl alcohol and corrosive sulfuric acid may be produced in the presence of water or moisture. Many authorities list an autoignition temperature for dimethyl sulfate of only 370°F.)

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Do not operate motorized equipment in potentially flammable atmospheres or where any dimethyl sulfate may be easily ignited due to its possibly low autoignition temperature. Consult qualified experts for advice as necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Dimethyl sulfate is heavier than water and of limited but fair solubility therein. It may be expected to sink to the bottom of a body of water and dissolve at an appreciable rate. The product will eventually react with water to form sulfuric acid and methyl alcohol. The reaction rate appears to be a function of temperature.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. If time permits containment and recovery of underwater pools of dimethyl sulfate, use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . If time permits these actions before underwater pools dissolve in or react with water, stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air and/or may be corrosive.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat to the contaminated water, followed by effective mixing, may capture some of the contaminants dissolved in the water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of suitable neutralization agent(s) to the contaminated water may reduce certain environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing methyl alcohol may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

Air bubbles entering the atmosphere will be contaminated with some amount of methyl alcohol vapors and possibly some small amounts of dimethyl sulfate vapors if the technique is effective and promptly applied.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1997

DINITROTOLUENES

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Dinitrotoluene (DNT) is a yellow solid at ambient temperatures or a clear oil with a distinctive odor. The major use of DNT is the production of toluene diisocyanate and toluenediamine that are intermediates in the making of polyurethane foams and polymers. DNT is produced by the nitration of toluene. It has a high boiling point at 300°C (572°F) and a negligible vapor pressure of 1 mm. Hg. It is insoluble in water, but soluble in acetone, alcohol, ether, ethanol and diethyl ether. Material is unstable at temperatures above 250°C (482°F) and is incompatible with strong oxidizing or reducing agents, alkalis, caustics and metals.

NIOSH lists dinitrotoluene as a potential occupational carcinogen. It is readily absorbed through all routes of exposure. Inhalation, ingestion or any tissue absorption can cause CNS depression and methemoglobinemia leading to cyanosis. Certain pre-existing disorders of the liver, cardiovascular system, bone marrow or skin may be increased from exposure to this material.

The material is a combustible solid but difficult to ignite, however it is an explosion hazard if heated and confined. It forms highly explosive mixtures with nitric acid. DNT spontaneously decomposes at 250°C, however contamination with other alkalis or organics can lower the decomposition temperature and increase the risk of explosion. DNT does not require air or oxygen to decompose. Products of decomposition are carbon dioxide, carbon monoxide and nitrogen oxides.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, .03 g/100g at 20°C (68°F)

Solubility in Other Chemicals: Soluble in acetone, alcohol, ether, ethanol and diethyl ether

Specific Gravity: 1.32 at 57°C (135°F)

Vapor Density (Air=1): 6.27

Boiling Point: 300°C (572°F)

Melting Point: 69.5° (157°F)

Freezing Point: 56°C (133°F) dry basis

Molecular Weight: 182.15

Heat of Combustion: -357 ± 5.9 kj/mol

Vapor Pressure: 1 mm Hg at 106°C (223°F)

Flash Point: 207°C (405°F) closed cup

Autoignition Temperature: Not available

Burning Rate: Not available

Flammable Limits: Not available

Stability: May be unstable at temperatures above 250°C (482°F).

Polymerization Potential: Will not occur

Reactivity and Incompatibility: Strong oxidizing or reducing agents, alkalis, caustics and metals.

IDENTIFICATION

Shipping Name(s): Dinitrotoluenes (liquid or solid) (USDOT & IMO); Dinitroltoluenes, molten (USDOT & IMO)

Synonyms and Tradenames: Binitrotoluene; DNT; Dinitrophenylmethane; Dinitrotoluol; 2,4- and 2,6-Dinitrotoluene; 1-Methyl-2,4- and 1-Methyl-2,6-Dinitrobenzene; Methyldinitrobenzene.

CAS Registry No: 25321-14-6.

Chemical Formula: $(NO_2)_2C_6H_3CH_3$

Constituent Components (% each): 80% 2,4-Dinitroltoluene and 20% 2,6-Dinitrotoluene; also reported 76% 2,4-Dinitrotoluene, 19% 2,6-Dinitrotoluene, and 5% other Mono/Di/Tri-Nitrotoluene isomers.

UN/NA Designation: UN2038 (solid or liquid); UN1600 (molten)

IMO Designation: 6.1

RTECS Number: XT1300000

NFPA 704 Hazard Rating: 3 (Health): 1 (Flammability): 3 (Reactivity)

Physical Form as Shipped: Sometimes shipped molten in tank cars or as a solid or liquid. Usually found in molten state. Commercial grade consisting of a mixture of 2,4-, 3,4- and 3,5- is an oily liquid.

Physical Form as Released: Solid, liquid or molten.

Color of the Shipped Material: Yellow crystalline solid at ambient temperature; clear oil.

Odor Characteristics: Distinctive

Reportable Quantity: See appendix I

Common Uses: The major use of DNT is the production of toluene diisocyanate and toluenediamine, which are intermediates in the making of polyurethane foams and polymers. It is also used to produce ammunition, explosives and dyes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

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DINITROTOLUENES

Division 6.1 (Poisonous Material)

*Also 1600

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: NIOSH lists dinitrotoluene as a potential occupational carcinogen. It is readily absorbed by all routes of exposure and can cause CNS depression and methemoglobinemia leading to cyanosis. Individuals with preexisting disorders of the liver, cardiovascular system, bone marrow or skin may have increased susceptibility to this material.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1.5 mg/m^3

Ceiling (C) Limit: Unavailable

IDLH: 50 mg/m^3

Conditions to Avoid: Avoid contact with strong oxidizers, strong reducing agents, alkalis, caustics, metals such as tin or zinc, heat, sparks, flame and high mechanical impact.

HEALTH HAZARDS

Potential Health Hazards: Material is readily absorbed through all routes of exposure and should be treated as a potential occupational carcinogen. It is harmful if swallowed, inhaled or absorbed through the skin. Inhalation, ingestion or tissue absorption may cause central nervous system depression and methemoglobinemia leading to cyanosis. Allergic skin sensitization is also possible. Individuals with preexisting disorders of the liver, cardiovascular system, bone marrow or skin may have increased susceptibility to this material.

Hazards of Skin or Eye Contact: Skin contact is not expected to cause skin irritation. However, central nervous system depression may occur. Symptoms may include nausea, vomiting, headaches, drowsiness, dizziness, weakness and loss of coordination, shortness of breath, rapid heart rate. Can also result in the production of methemoglobinema leading to cyanosis. Prolonged overexposure may cause mild skin rashes and other skin complications due to allergic skin sensitization. Contact with molten or hot fumes can cause sever burns and permanent eye damage may result.

Hazards of Inhalation: Inhalation of this material is not expected to cause irritation. However, central nervous system depression may occur. Symptoms may include nausea, vomiting, headaches, drowsiness, dizziness, weakness and loss of coordination. Can also result in the production of methemoglobinema leading to cyanosis. Chronic overexposure can lead to liver damage, jaundice, cyanosis and anemia.

Hazards of Ingestion: Ingestion can cause gastrointestinal irritation including nausea, diarrhea, lethargy and vomiting. This route of exposure may also lead to central nervous system depression. Symptoms may include nausea, vomiting, headaches, drowsiness, dizziness, weakness and loss of coordination. Can also result in the production of methemoglobinema leading to cyanosis. Chronic overexposure can lead to liver damage, jaundice, cyanosis and anemia.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: During fire, irritating and toxic forms of nitrogen oxides may be formed.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, and nitrogen oxides. Spontaneously decomposes at temperatures above 250°C (482°F). Air or oxygen are not needed for decomposition.

EXPLOSION HAZARDS

Explosive Potential: Combustible solid but difficult to ignite. Explosion hazard if heated, stricken, dropped or confined. Forms highly explosive mixture with nitric acid. Ignites on contact with sodium oxide. Contamination with other alkalis or organics can lower the decomposition temperature and increase the risk of explosion.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

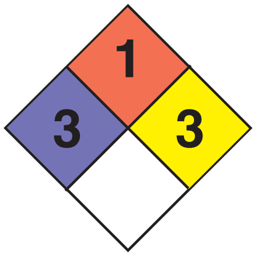
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn. Suitable materials of construction are Saranex® (longer than 8 hours). Natural rubber and nitrile rubber are not recommended for use due to a less than 1 hour breakthrough time. Wear a face-shield in case of potential splashing.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an

2038 *

DINITROTOLUENES

Division 6.1 (Poisonous Material)



*Also 1600

organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

FIRST AID

Nonspecific Symptoms: Dinitrotoluene is not expected to be an eye, skin or respiratory irritant. It is expected to be a gastrointestinal irritant with symptoms including nausea, diarrhea, vomiting and lethargy. However all routes of exposure can lead to CNS depression and can cause nausea, vomiting, headaches, drowsiness, dizziness, weakness and loss of coordination. Can also result in the production of methemoglobinema leading to cyanosis. Chronic overexposure can lead to liver damage, jaundice, cyanosis and anemia.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination

First Aid for Skin Contact: In case of skin contact, wash with soap and water. Remove contaminated clothing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large quantities of water and induce vomiting. Do not give anything by mouth if patient is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Special Note to Physicians: Absorption of this product into the body leads to the formation of methemoglobin which, in sufficient concentrations, leads to cyanosis. Since reversion of methemoglobin to hemoglobin occurs spontaneously after termination of exposure, moderate degrees of cyanosis may be treated with only supportive measures such as bed rest and oxygen inhalation. **Thorough cleansing of the entire body including scalp and nails is essential.** If cyanosis is severe, intravenous injection of methylene blue, 1 mm/kg body weight, may be of value. Cyanocobalamin (Vitamin B-12), 1 mg intramuscularly, will speed recovery. Intravenous fluids and blood transfusions may be indicated in severe exposures.

FIRE RESPONSE

Extinguishing Agents: Water, dry chemical, carbon dioxide or foam. If in liquid form, use ice, liquid carbon dioxide or water to render material in a solid form.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Dinitrotoluenes is a highly toxic liquid that may cause environmental contamination. Prevent substance from entering sewers, waterways and confined spaces. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Underflow dams are not an effective means to dike material since it can mix somewhat with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. **Saturated structural firefighting clothing must be decontaminated immediately.** Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Usually, dinitrotoluenes will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the substance is a solid.

CONSEQUENCE

Hazardous levels of dinitrotoluenes in air may be found in the local spill area and immediately downwind under appropriate circumstances. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of toxic vapors.

MITIGATION

Remove spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel, particularly if dry solid has spilled. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover all solid dinitrotoluenes with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will be contaminated.

MITIGATION

Handle covered material with care during site cleanup. Decontaminate cover or treat as hazardous waste for proper disposal.

TECHNIQUE

WATER SPRAY OR FOG . . . Water spray or fog applied to dinitrotoluenes, dust or mist, in air may reduce airborne concentrations.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments

TECHNIQUE

BURIAL . . . Under appropriate conditions, hot molten dinitrotoluenes may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of vapors or fumes.

CONSEQUENCE

An additional quantity of sand, earth or similar material will become contaminated.

MITIGATION

Consult qualified experts. Consider adding water as necessary to surface of cover material to cool spilled product.

DINITROTOLUENES

Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may be mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Solidify molten liquid using water, ice or carbon dioxide. Shovels, as well as a variety of heavy equipment such as backhoes and loaders may remove soil contaminated with spilled material.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Organize work to minimize dust generation. Decontaminate equipment.

DINITROTOLUENES
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may spread contaminate.

MITIGATION

Excavate as last resort, unless adverse environmental impacts can be minimized.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottoms sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

DI-n-PROPYLAMINE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Di-n-propylamine is a colorless liquid that is used for making other chemicals and has an amine or ammonia-like odor. It is moderately soluble in water and lighter, so may be expected to form a floating surface slick that quickly dissolves. Its flash point of 53°F indicates that it can be easily ignited under many ambient temperature conditions. Vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. There is some potential that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.1-6.2 pounds per gallon.

Di-n-propylamine does not react with water or many other common materials but does attack some forms of plastic and is reactive with a wide variety of chemicals. It is stable in normal transportation and corrosive to copper, aluminum, zinc, and galvanized surfaces. The liquid is a severe irritant to the eyes and skin while the vapor is irritating and rather toxic. If combustion is complete, products include carbon monoxide and nitrogen oxides. If oxygen is insufficient, products of combustion may additionally include highly toxic hydrogen cyanide, nitriles, cyanic acid, isocyanates, cyanogens, nitrosamines, amides, and carbamates.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Moderately soluble
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.736-0.741 at 68°F (20°C)
Boiling Point: 221-234°F (105-112°C) at 1 atm.
Melting Point: -39.3°F (-39.6°C)
Freezing Point: Unavailable
Molecular Weight: 101.19
Heat of Combustion: -10420 cal/g
Vapor Pressure: 21-22 mm Hg (0.406-0.425 psia) at 68°F (20°C)
Flash Point: 53°F (11.7°C), closed cup; 68°F (17°C), open cup; may be lower.
Autoignition Temperature: 570°F (299°C)
Burning Rate: 6.1 mm/minute
Stability: Stable
Corrosiveness: Corrodes copper, aluminum, zinc, and galvanized surfaces; may attack some plastics. Iron or steel not attacked.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with strong oxidizers, acids, halogens, peroxides, nitrous oxide, nitrites, aldehydes, halogenated organics, isocyanates, epoxides, alkali, alkaline earth elemental metals, strong reducing agents, and possibly dithiocarbamates.

IDENTIFICATION

Shipping Name: Dipropylamine (USDOT & IMO)
Synonyms and Tradenames: Dipropylamine; n-dipropy lamine; n-propyl-1-propanamine; DNPA
Chemical Formula: $(CH_3CH_2CH_2)_2NH$
Constituent Components(% each): 98% or more pure with some fraction water.
UN/NA Designation: UN2383
IMO Designation: 3.2, Flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Amine odor; ammonia-like; neutral to unpleasant.
Common Uses: Intermediate for making other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

DI-n-PROPYLAMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 0.1 ppm

Unusual Hazards: Flammable liquid. Poses moderate hazard via inhalation of vapors. Products of combustion may be highly toxic if combustion is incomplete.

Short Term Exposure Limits(STEL): Manufacturer implies 20 ppm for 15 minutes.

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, flames, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of vapors in air. Direct physical contact and ingestion may also have significant effects.

Hazards of Skin or Eye Contact: Skin contact with liquid di-n-propylamine may cause severe irritation or burns. Prolonged or repeated contact may result in sensitization. Contact with the eyes may result in eye damage leading to blindness.

Hazards of Inhalation: Vapors of di-n-propylamine irritate the eyes and mucous membranes of the respiratory tract. Higher levels in air may cause headache, dizziness, coughing, difficult breathing, and the possibility of delayed pulmonary edema or chemical pneumonitis with possibly severe consequences. Exposure to 1000 ppm for 4 hours is lethal to some rats.

Hazards of Ingestion: Ingestion may cause irritation and burning of the mouth and stomach, nausea, and vomiting. There may be potential for aspiration into the lungs during vomiting to result in delayed pulmonary edema and chemical pneumonitis with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: Somewhat less than 2.8% (estimated)

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Nitrogen oxides and carbon monoxide when combustion is complete. A variety of highly toxic substances when fire is oxygen starved. See general information section for details.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

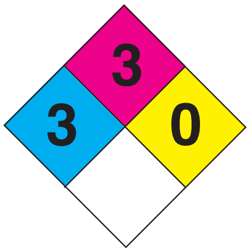
Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash- proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include polycarbonate. Butyl rubber may provide limited protection.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2383

DI-n-PROPYLAMINE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, mucous membranes of the respiratory tract, and other symptoms due to vapor exposure. Irritation or burns due to direct physical contact or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of milk or water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water fog, dry chemical, carbon dioxide, and alcohol foam. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fires in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that di-n-propylamine is a moderately volatile and toxic flammable liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Di-n-propylamine may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of di-n-propylamine in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Di-n-propylamine spills may expose downwind areas to toxic or flammable concentrations, particularly if large amounts have spilled and the weather is warm.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

DI-n-PROPYLAMINE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to di-n-propylamine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of di-n-propylamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of di-n-propylamine vapor into the atmosphere. (Note: the fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid di-n-propylamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent to liquid di-n-propylamine may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Di-n-propylamine may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained di-n-propylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

DI-n-PROPYLAMINE

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

DI-n-PROPYLAMINE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

Adsorption ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

DODECYLBENZENESULFONIC ACID
Class 8 (Corrosive Material)

GENERAL INFORMATION

Dodecylbenzenesulfonic acid, is a viscous, highly acidic, water-soluble and non-volatile liquid that may vary from being colorless to light yellow or brown. Although some product formulations may be odorless, others may evolve some amounts of highly toxic sulfur dioxide gas that may accumulate in containers and which has a sharp and pungent odor resembling burning sulfur. The lowest reported flash point of the material is 230°F (110°C) and indicates that substantial preheating may be necessary before the substance can be ignited easily. These acidic formulations are reported to attack most metals while evolving flammable and potentially explosive hydrogen gas. The liquid weighs 8.8 - 9.0 pounds per gallon.

Dodecylbenzenesulfonic acid does not react with water and is stable in normal transportation. As noted above, it is corrosive to most metals. It is also likely to attack some forms of plastics, rubber and coatings and, as a strong sulfonated acid, is otherwise reactive with a wide variety of other substances. The product is a highly corrosive liquid which should not be contacted or ingested. Products of combustion are reported to include irritating, corrosive, and/or toxic substances such as sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen sulfide, and carbon monoxide. They are also likely to include carbon dioxide, various other sulfur and organic compounds, and other harmful substances.

Downwind evacuation over more than relatively minor distances is generally unnecessary unless it is burning in a fashion that exposes vulnerable populations to harmful levels of its products of combustion. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, use professional judgment to determine if the exposure might be sufficient to cause violent rupture or explosion of the container. If it might be, evacuate for a radius of one-half (1/2) mile for protection from flying debris.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Generally soluble in all proportions.

Solubility in Other Chemicals: Not available.

Specific Gravity (Liquid): Reported as 1.06 - 1.08 at 77°F (25°C).

Boiling Point: 572°F (300°C) at 1 atm.

Melting Point: Not available.

Freezing Point: Not available.

Molecular Weight: 316 - 318 for commercial product formulation; 326.5 for pure substance.

Heat of Combustion: Not available.

Vapor Pressure: Apparently very low at ambient temperatures.

Flash Point: 230°F (110°C), closed-cup; 300°F (148.9°C), open-cup.

Autoignition Temperature: Not available.

Burning Rate: Not available.

Stability: Stable.

Corrosiveness: Reported to attack most metals while evolving flammable and potentially explosive hydrogen gas. Specifically stated as incompatible with carbon steel and aluminum. One authority says that product formulations should be handled in type 316 stainless steel or fiberglass with Atlac 382 corrosion liner. Specially lined steel drums also appear suitable for use. The product is considered likely to attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Available data are limited. Generally reported as incompatible with amines, strong alkalis, cyanides, oxidizing agents, reducing agents, sulfides and combustible materials. One source says that contact with acids can result in emission of highly toxic sulfur oxides.

IDENTIFICATION

Shipping Names: Dodecylbenzenesulfonic acid (for U.S. shipments only); international shipments may possibly use "alkyl sulfonic acid, liquid" as the proper shipping name or a suitable alternative name.

Synonyms and Tradenames: Benzenesulfonic acid, dodecyl ester; DDBSA; n-dodecylbenzenesulfonic acid; laurylbenzenesulfonic acid; and many tradename products including but not limited to Bio-Soft S-100, Conoco SA 597, and Nacconol 988A.

Chemical Formula: $CH_3(CH_2)_{11}C_6H_4S0_3H$ or $C_{18}H_{30}S0_3$

Constituent Components (% each): Products made in the U.S. are apparently more than 95% pure with the remainder consisting of sulfuric acid and possibly some amount of "unsulfonated material".

UN/NA Designation: NA2584 for U.S. shipments.

IMO Designation: 8, corrosive material.

Physical State As Shipped: Viscous liquid.

Physical State As Released: Viscous liquid.

Color of the Shipped Material: May vary from colorless to light yellow to brown.

Odor Characteristics: May be odorless, or if sulfur dioxide is being evolved, may smell sharp and pungent like burning sulfur.

Common Uses: Used in a wide variety of detergents and cleaning agents; an intermediate for making emulsifiers and wetting and foaming agents.

DODECYLBENZENESULFONIC ACID
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available

Unusual Hazards: May potentially evolve toxic sulfur dioxide gas; contact with incompatible metals may result in evolution of flammable and potentially explosive hydrogen gas; both gases may accumulate in containers. Use of water or foam on fires must be undertaken carefully to avoid frothing, spattering, and potential tank boilover hazards. Otherwise, be advised that any spilled material is slippery.

Short Term Exposure Limit (STEL): Not formally established for product of concern; 5 ppm for sulfur dioxide for 15 minutes (ACGIH, 1992 - 93; OSHA, 1989); 3 mg/ml for sulfuric acid for 15 minutes (ACGIH, 1992 - 93).

Time Weighted Average (TWA) Limit: Not formally established for product of concern; 2 ppm for sulfur dioxide; 1 mg/m^3 for sulfuric acid; both over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989) when considered separately. Seek qualified advice where necessary.

Conditions to Avoid: Heat, hot surfaces, or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: In the absence of a significant vapor pressure at ambient temperatures, it appears that inhalation exposures will be of significant concern only when this product formulation evolves highly toxic sulfur dioxide gas. Otherwise, the product is a corrosive, non-volatile liquid.

Hazards of Skin or Eye Contact: Contact of the highly acidic liquid product or its mists or vapors with the eyes is variably reported to cause irritation, redness, pain, lacrimation, blurred vision, swelling, severe chemical burns, corneal injury, and/or possibly permanent impairment of vision or blindness. Contact of the skin with the liquid product, depending upon its free sulfuric acid content, may either rapidly or upon prolonged or repeated contact cause defatting, redness, swelling, pain, severe burns, and possibly permanent damage. Even 0.5 to 1.0% concentrations in water have been observed to cause significant irritation. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Vapors or mists of dodecylbenzenesulfonic acid are reported to be irritating and harmful to the nasal passages and respiratory tract. Any mists or fumes of sulfuric acid present at high concentrations in air may be expected to have the potential to cause effects such as sneezing, coughing, difficult breathing, laryngeal, tracheobronchial and/or pulmonary edema (which may be delayed in onset), and/or chemical pneumonia with possibly severe consequences. Any sulfur dioxide present may cause irritation of the nose, throat, and lungs at levels as low as 10 ppm in air. Higher levels may cause similar effects such as choking, coughing, difficult breathing, chest tightness, delayed chemical pneumonia, and possibly death due to respiratory paralysis.

Hazards of Ingestion: Effects of ingestion of the highly acidic liquid are variably reported to include irritation or burns of the mouth, throat, and stomach, with symptoms such as intestinal distention, gastrointestinal irritation, headache, nausea, vomiting, and diarrhea. Note that concentrated sulfuric acid has the potential to additionally cause perforation of the esophagus or stomach, staining and erosion of teeth, vomiting of blood and eroded tissue, and possibly death. Laboratory experiments have shown that single oral doses required to kill 50% of rats range from 0.65 to 2.3 grams of dodecylbenzenesulfonic acid per kilogram of an animal's body weight; the corresponding range for mice is 1.4 to 1.8 g/kg.

FIRE HAZARDS

Lower Flammable Limit: Not available.

Upper Flammable Limit: Not available.

Behavior in Fire: Exposure to high temperatures and a source of ignition may result in ignition of spilled liquid. The high boiling point and low vapor pressure of the product make a significant probability of rupturing or exploding unlikely. It may be prudent, nevertheless, to take appropriate precautions if a closed container is exposed to a large and hot fire for a relatively prolonged period of time.)

Hazardous Combustion Products: Not well-defined; reported to include highly irritating and toxic gases, fumes, and mists of sulfur dioxide (SOA sulfur trioxide (S03), sulfuric acid, hydrogen sulfide (H2S), and carbon monoxide. Likely to also include carbon dioxide, various other sulfur and organic compounds, and other harmful substances.

EXPLOSION HAZARDS

Explosiveness: See "Behavior in Fire" section above for discussion of container rupture potential. Note that these product formulations are reported to attack most metals while evolving flammable and potentially explosive hydrogen gas.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof

2584

DODECYLBENZENESULFONIC ACID
Class 8 (Corrosive Material)

PROTECTIVE CLOTHING AND EQUIPMENT *(CONTINUED)*

safety goggles, and other impervious and acid-resistant clothing for normal operations. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with products of combustion during firefighting operations. An acid-resistant slicker type suit and rubber gloves, boots, and a SCBA are suggested for non-fire spill situations. Compatible materials for the product itself may include chlorinated polyethylene, neoprene, nitrile rubber, and polyvinyl chloride. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: For unknown concentrations, fire fighting, general use, or high concentrations, use a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For normal or cleanup operations where low levels of vapors or mists may be encountered, an approved full facepiece air-purifying cartridge type respirator equipped for organic vapors/mists and acid gases may provide adequate performance within the use limitations of such devices. Seek expert advice for selection and use of a respirator type appropriate for the contaminant levels and exposures being encountered.

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; sneezing, coughing, difficult breathing, headache, nausea, vomiting, diarrhea, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. If skin is not damaged, perform final wash with soap and water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If conscious, have victim wash out mouth with water (which should not be swallowed) and then drink large quantities of water immediately. Do not attempt to make the victim vomit, since vomiting may result in further damage to the throat and esophagus. If available, follow water with administration of milk of magnesia or aluminum hydroxide gel in an equal amount of water. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Regular or alcohol foam both may be effective to some degree. Be advised that application of water or foam as a direct stream onto the burning liquid may result in potentially violent frothing or spattering; entry into burning tanks of the product may possibly result in violent frothing or boilover that may be hazardous to nearby personnel. Apply water or foam as a spray with caution and from a distance at first. Water may possibly be used on smaller spills to dilute discharged liquid to a nonflammable mixture.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with fumes from hot liquid or smoke from fire is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to extreme heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after the fire is out but do not direct water streams into burning containers. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines as necessary prior to use. One manufacturer says to avoid "free fall" of the liquid while another with a product reported to evolve sulfur

DODECYLBENZENESULFONIC ACID
Class 8 (Corrosive Material)

SPILL RESPONSES *(CONTINUED)*

dioxide gas says to vent containers frequently, and more often in warm weather, to relieve any pressure. Also said is not to use pressure to empty containers. Take the corrosivity, reactivity, and other unusual hazards and characteristics of the product into account while planning the response. Remember that sulfur dioxide and/or hydrogen gas may accumulate in some containers.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION. . . Dodecylbenzenesulfonic acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, but give special attention to the possibility that sulfur dioxide may evolve from some product formulations.

CONSEQUENCE

Hazardous levels of the product or other substances may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind as appropriate.

TECHNIQUE

WATER FOG OR SPRAY . . . Where deemed necessary, water fog or spray may be applied to any vapors or mists in air to absorb vapors, knockdown mists, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts (if any) of various chemicals from contact with vapors or mists.

MITIGATION

Where necessary, contain contaminated water and neutralize and/or remove it as soon as possible and as necessary to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam (either regular or alcohol type, see "Extinguishing Materials") may be applied to the surface of liquid pools to possibly slow the release of chemical vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. Application of foam to a very hot liquid product may cause violent frothing.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply foam to very hot liquid with extreme caution at first.

TECHNIQUE

DILUTION . . . Where deemed necessary, the addition of a relatively large amount of water to liquid dodecylbenzenesulfonic acid may slow the release of various gases, vapors, or fumes into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Contact of water with very hot liquid product may cause violent frothing. Water streams may result in considerable foaming of the product, which may or may not be desirable.

MITIGATION

Add water gently to the product in a manner that minimizes foaming if desired. Where necessary, contain liquid and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Apply water to very hot liquid with extreme caution at first.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid dodecylbenzenesulfonic acid or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in spread of contamination.

DODECYLBENZENESULFONIC ACID
Class 8 (Corrosive Material)

LAND SPILL *(CONTINUED)*

MITIGATION

Contain liquid and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION.. . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged, develop leaks, and/or be corroded in a manner that generates flammable and potentially explosive hydrogen gas.

MITIGATION

Use equipment compatible with the spilled product or neutralize contained liquids prior to recovery.

TECHNIQUE

ABSORPTION.. . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire. Corrosivity hazards to cleanup personnel may be mitigated by neutralizing the liquid prior to recovery.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques. If soda ash is used, provide adequate ventilation to dissipate the carbon dioxide gas that will be generated.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors or gases present in the area, such as hydrogen gas generated by the action of sulfuric acid in the product on various metals, may possibly be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Even small amounts of the product can cause foaming in water since the material is essentially a detergent.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Neutralization may also be necessary.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

CHEMICAL TREATMENT . . . Application of appropriate chemical agent(s) to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

FOAMING . . . Water containing dissolved detergent such as dodecylbenzenesulfonic acid may be decontaminated to some degree by aeration techniques. This requires the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

Large amounts of foam may be generated and may be difficult to capture and place in proper storage until it collapses if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment and in applying this technique. Consider treating contained water via a processing system constructed on land.

March 1995

EPICHLOROHYDRIN
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Epichlorohydrin is a colorless liquid with a sweet, pungent, irritating odor that may resemble garlic or chloroform. It is used as a solvent and in making resins, glycerol, rubber, stabilizers, and chemicals for paints, varnishes, and lacquers. It is 6.6% soluble in water by weight and somewhat heavier, so may be expected to sink and dissolve at a moderate rate. Its flash point of 87°F indicates that it may be easily ignited in warm ambient temperature conditions. In such situations, vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flashback. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 9.8 pounds per gallon.

Epichlorohydrin reacts mildly with water. Although stable in normal transportation, acids, bases, certain salts, or excessive heat (temperatures above 617°F) may initiate self-polymerization in a reaction that may cause violent rupture of the container. The product may react violently with magnesium and aluminum and their alloys, and will pit steel when wet. It is reactive with a variety of other chemicals and substances and will attack some kinds of plastics, rubbers, and coatings. Vapors of epichlorohydrin are irritating and highly toxic. The liquid is injurious to the eyes and skin and highly toxic by ingestion. Products of combustion may include highly toxic phosgene, hydrogen chloride, and carbon monoxide gases.

Downwind evacuation should be considered if the product is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 6.6% W at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, carbon tetrachloride, benzene, ether, and most organic solvents.

Specific Gravity (Liquid): 1.176 at 68°F (20°C)

Boiling Point: 239.4-244.2°F (115.2-117.9°C) at 1 atm.

Melting Point: -71°F (-57.2°C)

Freezing Point: -71°F (-57.2°C)

Molecular Weight: 92.53

Heat of Combustion: -4524 cal/g

Vapor Pressure: 12.5 mm Hg (0.242 psia) at 68°F (20°C)

Flash Point: 87°F (30.6°C), closed cup; 91-105°F (32.8-40.6°C), open cup.

Autoignition Temperature: 772-804°F (411-429°C)

Burning Rate: 2.6 mm/minute

Stability: Stable in normal transportation. May polymerize under conditions described above.

Corrosiveness: Reacts with magnesium and aluminum and their alloys; wet product will pit steel. Attacks some kinds of plastics, rubbers, and coatings. Penetrates leather easily.

Reactivity with Water: Mild reaction.

Reactivity with Other Chemicals: Reacts with acids; caustics; bases such as ammonia and amines; sodium, potassium, magnesium, aluminum and other chemically active metals and their alloys; metal halides such as iron chloride; 2-aminoethanol; ethyleneimine; ethylene diamine; potassium tert-butoxide; and strong oxidizers.

IDENTIFICATION

Shipping Names: Epichlorohydrin (USDOT and IMO)

Synonyms and Tradenames: 3-chloro-1,2-epoxypropane; 2- chloropropylene oxide; epichlorhydrin; gamma-chloropropylene oxide; 1-chlor-2,3-epoxypropane; chloromethyloxirane; (chloromethyl) ethylene oxide; 3-chloro-1,2-propylene oxide; epichlorophydrin; 1,2-epoxy-3-chloropropane; 2,3-epoxypropyl chloride; EPI; ECH; glycidyl chloride; glycerol epichlorohydrin; alpha-epichlorohydrin.

Chemical Formula: CH_2OCHCH_2Cl

Constituent Components(% each): 99% min purity with 0.10% water max

UN/NA Designation: UN2023

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sweet, pungent, irritating, like garlic, like chloroform.

Common Uses: Curing rubber; solvent; mfg. of resins, glycerol, stabilizer for chlorine-containing materials, paints, varnishes, lacquers, cement for celluloid, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

EPICHLOROHYDRIN

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10 ppm

Unusual Hazards: Flammable liquid that may self-polymerize at high temperatures. Product is highly toxic via all routes of exposure.

Short Term Exposure Limits(STEL): (Skin) 5 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 2 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is due to inhalation of vapors in air. The product is also highly toxic by ingestion or direct physical contact. Repeated or prolonged exposure may cause liver, lung, and kidney injury as well as sterility. Earliest symptoms may involve gastrointestinal distress or pain in the region of the liver. The product is a carcinogen to animals.

Hazards of Skin or Eye Contact: Contact of the skin with liquid epichlorohydrin may result in delayed blistering and deep-seated pain. The product may be absorbed through the skin in toxic amounts and may cause occasional sensitization and an allergenic skin condition. Contact with the eyes may cause severe irritation and possible tissue damage.

Hazards of Inhalation: Vapors of epichlorohydrin are irritating tothe eyes, nose, and respiratory tract at levels as low as 20-40 ppm in air. High levels may cause central nervous system depression with symptoms including headache, nausea, vomiting, coughing, difficult breathing, blue coloration of the skin (cyanosis) and possibly death. Breathing difficulties may be delayed by several hours and may involve chemical pneumonitis. Exposure to 250 ppm in air for 4 hours kills some rats while 7400 ppm kills some mice in 30 minutes.

Hazards of Ingestion: Ingestion of as little as 1 gram of epichlorohydrin could be fatal. Symptoms may include vomiting, convulsions, rapid pulse, and respiratory paralysis.

FIRE HAZARDS

Lower Flammable Limit: 3.8%

Upper flammable limit: 21%

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Exposure of containers to fire may result in violent polymerization and container rupture.

Hazardous Combustion Products: May include toxic phosgene, hydrogen chloride, and carbon monoxide gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Excessive heat may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in the presence of acids, bases, and certain salts.

PROTECTIVE CLOTHING AND EQUIPMENT

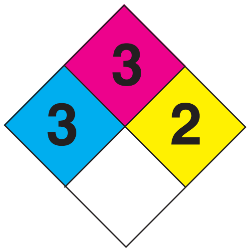
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2023

EPICHLOROHYDRIN

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, or respiratory tract due to vapor exposure, as well as other symptoms of inhalation or ingestion. Blisters, pain, or injury due to direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water, saltwater, or milk immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical (unless fire is in container with confined vent), water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that epichlorohydrin is a toxic and flammable substance. Violent polymerization may occur under conditions described in the General Information section. Violent reactions may occur in the presence of magnesium or aluminum or their alloys.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Epichlorohydrin spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

EPICHLOROHYDRIN
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to epichlorohydrin vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of epichlorohydrin from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... Alcohol foam applied to the surface of liquid pools may slow the release of epichlorohydrin vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid epichlorohydrin may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impound ments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Epichlorohydrin may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained epichlorohydrin may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

EPICHLOROHYDRIN

Division 6.1 (Poisonous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, saw dust, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

EPICHLOROHYDRIN
Division 6.1 (Poisonous Material)

TECHNIQUE

Adsorption ... Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

CONTAINMENT ... Spilled product may sink in slowly flowing water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination, particularly if water volume is limited.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts. Epichlorohydrin may rapidly dissolve or react with water, thus rendering this response ineffective.

MITIGATION

Excavate as last resort. Use other containment methods if conditions are appropriate for rapid dissolution in water.

TECHNIQUE

DREDGING/PUMPING ... Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air. Epichlorohydrin may dissolve or react with water before this response can be implemented.

MITIGATION

Consult qualified experts for guidance. Use hoses and pumps or vacuum trucks promptly after spillage.

September 2000

ETHANOLAMINE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Ethanolamine is a colorless liquid with a fishy, ammoniacal odor. It is used to make pharmaceuticals, ammonia, detergents, wool treating agents, paints, polishes, corrosion inhibitors, and other products and chemicals. It is fully soluble in water and will mix freely in all proportions. Its flash point of 185°F indicates the product must be heated before ignition may occur. There is some very limited potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weights approximately 8.5 pounds per gallon.

Ethanolamine does not react with water, but some heat will be evolved as it mixes. It is stable in normal transportation, and corrosive to copper, brass, other copper alloys and some types of plastic, rubber and coatings. There is a possibility that reactions with nitrides may be explosive. The product is of low volatility but vapors may be toxic at relatively low concentrations in air. Products of combustion may be toxic and may include nitrogen oxides and other substances.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.
Solubility in Other Chemicals: Soluble in acetone, chloroform, and methanol; slightly soluble in benzene.
Specific Gravity (Liquid): 1.02 at 68°F (20°C)
Vapor Density: 2.1
Boiling Point: 338 - 342°F (170 - 172.2°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: 50.5°F (10.3°C)
Molecular Weight: 61.1
Heat of Combustion: -5950 cal/g
Evaporation Rate (butyl acetate=1): 0.02
Vapor Pressure: 0.48 mmHg (0.009 psia) at 68°F (20°C)
Flash Point: 185°F (85°C), closed cup; 200°F (93.3°C), open cup.
Autoignition Temperature: 770°F (410°C)
Burning Rate: Unavailable
Flammable Limits: 5.5% (LEL) - 17% (UEL)
Stability: Stable; heat contributes to instability
Polymerization Potential: Will not occur.
pH: The substance is a medium strong base.
Corrosiveness: Attacks copper, brass, other copper alloys, and some forms of plastics, rubber, and coatings. Stainless steel and aluminum are recommended for use with the product.
Reactivity with Water: No reaction but some heat will be evolved.
Reactivity and Incompatibility: May react with mineral acids, strong oxidants, peroxides, organic acids and anhydrides, isocyanates, epoxides, azo or diazo compounds, hydrazines, alkali and alkaline earth elemental metals, strong reducing agents, nitrides, aldehydes, halogenated organics, dithiocarbamates, vinyl acetate, beta-propiolactone, mesityl oxide, epichlorohydrin, acrylonitrile, and acrolein.

IDENTIFICATION

Shipping Name(s): Ethanolamine or Ethanolamine, solutions (USDOT & IMO)
Synonyms and Tradenames: Ethanolamine; 2-Aminoethanol; beta-Aminoethyl Alcohol; 2-Hydroxyethylamine; Colamine; beta-Ethanolamine; Glycinol; beta-Hydroxyethylamine; MEA; Olamine; Thiofac m-50; Ethylolamine; USAF EK-1597; Amino-ethyl alcohol.
CAS Registry No.: 141-43-5
Chemical Formula: $HO(CH_2)_2NH_2$
Constituent Components (% each): 85% in water or 99% or more pure with trace water.
UN/NA Designation: UN2491
IMO Designation: 8, Corrosives
RTECS Number: KJ5775000
NFPA 704 Hazard Rating: 3(Health): 2(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid; solidifies at 50.5°F (10.3°C)
Color of the Shipped Material: Colorless
Odor Characteristics: Mildly ammoniacal, fishy.
Reportable Quantity: See appendix I.
Common Uses: Scrubbing of acid gases; softening of hides; mfg. of mordants, pharmaceuticals, ammonia, detergents, wood treating agent, emulsion paints, polishes, agricultural sprays, corrosion inhibitor, rubber accelerator, and other chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ETHANOLAMINE

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 2-4 ppm
Unusual Hazards: Concentrated vapors are quite toxic.
Short Term Exposure Limit (STEL): 6 ppm (15 mg/m^3)
Time Weighted Average (TLV-TWA): 3 ppm (8 mg/m^3)
Ceiling (C) Limit: Unavailable
IDLH: 30 ppm
Conditions to Avoid: Heat and fire; incompatible materials; runoff to water bodies; inhalation, ingestion, and direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of high vapor concentrations in air. Ingestion and direct physical contact with liquid or solid ethanolamine are also to be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with liquid or solid ethanolamine may cause redness and irritation. Contact with the eyes may cause severe eye irritation and possibly severe injury. The liquid can be absorbed somewhat through the skin.

Hazards of Inhalation: Vapors of ethanolamine may irritate the eyes, nose, and respiratory tract. Severe exposure may result in narcosis or delayed pulmonary edema with possibly severe consequences, or injury to the liver and kidneys. A concentration of 223 ppm in air was lethal to 4 of 6 guinea pigs in one hour in laboratory experiments.

Hazards of Ingestion: Ingestion of ethanolamine may, at the very least, result in damage to the throat and esophagus.

FIRE HAZARDS

Lower Flammable Limit: 5.5%
Upper Flammable Limit: 17%
Behavior in Fire: Combustible liquid. Will burn but difficult to ignite. There is some limited potential that containers may rupture violently in fire.
Hazardous Decomposition Products: Nitrogen oxides and other toxic products of organic substances. Incomplete combustion gives carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: There is some very limited potential that containers may rupture violently in fires. Contact with other chemicals such as nitrides may result in formation of explosive mixtures. Explosion may result if vapors from heated liquid are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Butyl rubber, neoprene, nitrile rubber and Vitol® are reported to provide more than 8 hours of protection. Other compatible materials may include natural rubber, nitrile rubber/polyvinyl chloride, polyethylene, chlorinated polyethylene, polyurethane, polyvinyl alcohol, polyvinyl chloride, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 150 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge for ethanolamine (150 ppm or less) or an air purifying respirator (APR) with organic vapor cartridge for ethanolamine (150 ppm or less) with a full facepiece within the use limitations of these devices.

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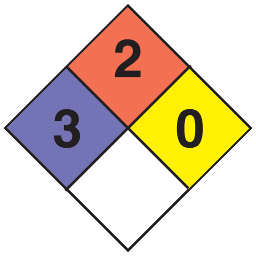
ETHANOLAMINE

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, skin, throat, or esophagus; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious, administer artificial respiration. Administer oxygen if victim remains unconscious or breathing is difficult. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Alcohol resistant foam, dry chemical, carbon dioxide, water spray or fog. Water may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethanolamine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethanolamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ETHANOLAMINE
Class 8 (Corrosive Material)

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid ethanolamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL RESISTANT FOAM . . . There is a possibility that alcohol resistant foam applied to the surface of liquid pools may slow the release of ethanolamine vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol resistant foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Liquid ethanolamine may be confined by building dikes or barriers using soil, sand or other materials. Note: Ethanolamine may solidify at temperatures below 50.5°F (10.3°C).

CONSEQUENCE

Confined ethanolamine may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

ETHANOLAMINE
Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment after use. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. Cation exchangers may also be effective.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent or cation exchanger on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

This page may be used for notes.

January 1988

ETHYL ACETATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl acetate is a fairly volatile colorless liquid with a pleasant and fruity odor. It is used as a solvent for lacquers, shellacs, varnishes, dopes, coatings and other products, and has several other uses. It is significantly soluble in water and lighter, so may be expected to form a floating surface slick that dissolves fairly rapidly. Its flash point of 24°F indicates that the product can be easily ignited under a wide range of ambient temperature conditions. Vapors may be somewhat heavier than air and may travel a significant distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.5 pounds per gallon. Ethyl acetate does not react with water or many other common materials and is stable in normal transportation. It is reactive with various chemicals, however, and may attack some plastics, rubber, or coatings. Toxicity is low to moderate by the various potential routes of exposure, but relatively high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 8.7 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 0.902 at 68°F (20°C)
Boiling Point: 171°F (77°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –117°F (–83°C)
Molecular Weight: 88.11
Heat of Combustion: –5616 cal/g
Vapor Pressure: 76 mm Hg (1.47 psia) at 68°F (20°C)
Flash Point: 24°F (–4.4°C), closed cup; 28–55°F (–2.2 to 12.8°C), open cup.
Autoignition Temperature: Min. 752°F (400°C); max. 907°F (486°C); reported values vary
Burning Rate: 3.7 mm/minute
Stability: Stable, but hydrolyzes upon long standing to form acetic acid and ethyl alcohol.
Corrosiveness: May attack some plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with nitrates, strong oxidizers, strong alkalies, and strong acids

IDENTIFICATION

Shipping Names: Ethyl acetate (USDOT and IMO)
Synonyms and Tradenames: Acetic acid, ethyl ester; acetic ether; ethyl ethanoate, acetic ester; vinegar naphtha.
Chemical Formula: $CH_3C0_2CH_2CH_3$
Constituent Components(% each): 85–100% pure with remainder mostly ethyl alcohol (see separate guide)
49 STCC: 49 091 60
UN/NA Designation: UN1173
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pleasant, fruity, sweet
Common Uses: Solvent for lacquers, shellacs, varnishes, dopes, coatings, inks, rubber, resins; mfg. of smokeless powder, artificial leather, photo film, linoleum, plastic wood, dyes, pharmaceuticals, and other products.

ETHYL ACETATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor **Concentration:** 0.0056–70 ppm; reported values vary widely.

Unusual Hazards: Fairly volatile flammable liquid. Vapors may be somewhat heavier than air and may travel to a source of ignition.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 400 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the local spill area and some distance downwind.

Hazards of Skin or Eye Contact: Repeated or prolonged contact of the skin with liquid ethyl acetate may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Contact with the eyes may result in painful but temporary irritation. '

Hazards of Inhalation: Vapors of ethyl acetate may be irritating to the eyes, nose, and throat. High concentrations in air may cause narcosis and central nervous system depression with symptoms including weakness, drowsiness, headache, dizziness, nausea, unconsciousness, and possibly death. Severe acute exposures may result in pulmonary edema with hemorrhage and hyperemia of the respiratory tract.

Hazards of **Ingestion:** Data unavailable. Product is of relatively low oral toxicity in animal experiments.

FIRE HAZARDS

Lower Flammable Limit: 2–2.2%

Upper Flammable Limit: 11–11.5% (one source gives 9%)

Behavior in Fire: Flammable liquid. May generate significant amounts of flammable vapor upon release. Vapors may be heavier than air and may travel a significant distance to a source of ignition and flash back. There is some limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

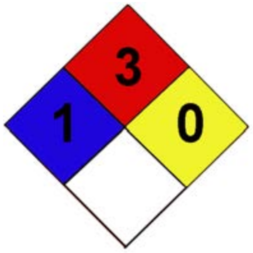
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible substances may include butyl rubber, chlorinated polyethylene, polyurethane, polyvinyl alcohol, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (10,000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1173

ETHYL ACETATE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, or skin; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective but may be used in large amounts to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering servers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl acetate may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the appreciable volatility and flammability of ethyl acetate into account while planning the response. Note that oil spill containment and cleanup methods may be useful in early response stages before ethyl acetate dissolves in water.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl acetate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

MONITOR THE SITUATION . . . Ethyl acetate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of ethyl acetate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb ethyl acetate vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethyl acetate from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of ethyl acetate vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid ethyl acetate may slow the release of vapors into the atmosphere. (Note: All ethyl acetate must be dissolved in water.)

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethyl acetate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ethyl acetate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ETHYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid, with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ETHYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards if the spilled product has had time to hydrolyze to acetic acid and ethyl alcohol.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

ETHYL ACRYLATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl acrylate is a colorless liquid with a sharp acrid slightly nauseating odor that may resemble hot plastic. It is used as the raw material for acrylic resins used in paints, plastic films, adhesives, textiles, and paper. Slightly soluble in water and lighter, it may be expected to form a floating surface slick that slowly dissolves. Its lowest reported flash point of 44°F indicates that it can easily be ignited under a wide range of ambient temperature conditions. Vapors are slightly heavier than air at warm temperatures and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 7.7 pounds per gallon.

Ethyl acrylate does not react with water or many other common materials. Although it is stable in normal transportation when shipped with an inhibitor, exposure to moisture, light, high temperatures, or certain chemicals such as peroxides may initiate self-polymerization in a reaction that may cause violent rupture of its container. The product is generally considered to be moderately toxic by the various routes of exposure. Products of combustion may be toxic and irritating.

Downwind evacuation should be considered if ethyl acrylate is leaking from its container but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 1.5 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, chloroform, and ether.

Specific Gravity (Liquid): 0.923 at 68°F (20°C)

Boiling Point: 211.3°F (99.6°C) at 1 atm.

Melting Point: –98°F (–72°C)

Freezing Point: –98°F (–72°C)

Molecular Weight: 100.12

Heat of Combustion: –6600 cal/g

Vapor Pressure: 29.5 mm Hg (0.570 psia) at 68°F (20°C)

Flash Point: 47°F (8.3°C), closed cup; 44–67°F (6.7–19.4°C), open cup.

Autoignition Temperature: 721°F (382.8°C)

Burning Rate: 4.3 mm/minute

Stability: Stable (stored in presence of air) but may polymerize under conditions described above.

Corrosiveness: Not corrosive to usual materials of construction.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with peroxides, other initiators of polymerization, strong alkalis, atmospheric moisture, oxidizing agents, and oxides.

IDENTIFICATION

Shipping Names: Ethyl acrylate, inhibited (USDOT); ethyl acrylate (IMO).

Synonyms and Tradenames: 2-Propenoic acid, ethyl ester; acrylic acid, ethyl ester; ethyl propenoate; ethyl 2-propenoate.

Chemical Formula: $CH_2{=}CHCOOCH_2CH_3$

Constituent Components (% each): 98.5–99.5% pure with 13–17 ppm methyl ether of hydroquinone as polymerization inhibitor.

49 STCC: 49 072 15

UN/NA Designation: UN1917

IMO Designation: 3.2, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sharp, acrid, slightly nauseating; pungent, like hot plastic.

Common Uses: Raw material for acrylic resins used in paints, plastic films, adhesives, textiles, paper, and denture materials.

ETHYL ACRYLATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Less 1 ppm
Unusual Hazards: Flammable liquid of moderate toxicity. Vapors may be heavier than air. Excessive heat, chemical contamination, light, or moisture may cause self-polymerization resulting in violent container rupture.
Short Term Exposure Limits (STEL): (Skin) 25 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): (Skin) 5 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; light, or moisture in containers; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Ethyl acrylate is moderately toxic by all potential routes of exposure. Major hazard is from inhalation of the high vapor concentrations that may be present in the immediate spill area and directly downwind.
Hazards of Skin or Eye Contact: Prolonged contact of the skin with liquid ethyl acrylate may cause moderate to severe damage involving marked local irritation, redness, edema, thickening, and vascular damage. Skin sensitization may occur and toxic amounts may be absorbed through the skin. Prolonged contact with the eyes may cause severe corneal injury.
Hazards of Inhalation: Vapors of ethyl acrylate are irritating to the eyes and upper respiratory tract and will cause tearing. High concentrations in air may cause shortness of breath, drowsiness, nausea, headache, convulsions, pulmonary edema, and possibly death. Exposure to 2000 ppm for 4 hours was fatal to rats in laboratory experiments.
Hazards of Ingestion: Ingestion may cause severe irritation of the mouth and digestive tract, dizziness, difficult breathing, cyanosis, convulsions, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 1.8%
Upper Flammable Limit: 6.3–12.1%; reported values vary
Behavior in Fire: Flammable liquid. May generate quantities of flammable vapor upon release. Vapor may be heavier than air and may travel to a source of ignition and flash back. Containers may rupture violently in fire.
Hazardous Combustion Products: Considered toxic and irritating, may include unburned ethyl acrylate.

EXPLOSION HAZARDS

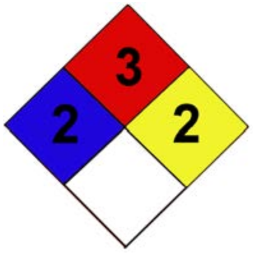
Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat or light may cause spontaneous violent polymerization resulting in violent container rupture. Violent polymerization may also occur in the presence of certain chemical contaminants.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (1000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1917

ETHYL ACRYLATE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if there is skin irritation.

First Aid for **Ingestion:** If victim is conscious, administer two glasses of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting not be induced if immediate medical attention is available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl acrylate may result in damage, rupture, or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment where possible that is not corroded or otherwise damaged by the spilled product. Take the toxic and flammable nature of ethyl acrylate into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl acrylate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl acrylate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain. a small amount (if any) of ethyl acrylate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ETHYL ACRYLATE
Class 3 (Flammable Liquid)

TECHNIQUE '

FOAM . . . There is an unconfirmed possibility that firefighting foam applied to the surface of liquid pools may slow the release of ethyl acrylate vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative techniques if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethyl acrylate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ethyl acrylate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ETHYL ACRYLATE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating ethyl acrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

ETHYL ACRYLATE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with ethyl acrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ETHYL ALCOHOL

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl alcohol is a colorless liquid with a characteristic, sweet, ethereal odor like wine or whiskey. It is essentially fully soluble in water. It is the alcohol present in all alcoholic beverages, but quantities being transported may contain chemical denaturants such as methyl isobutyl ketone, ethyl acetate, methanol, heptane, gasoline, or kerosene that render the product unfit for human consumption. Industry uses ethyl alcohol as a solvent and for making dyes, pharmaceuticals, elastomers, detergents, cosmetics, antifreeze, explosives, chemicals, and a wide variety of other products. The pure alcohol has a flash point of 55°F, but this can vary up or down depending on the type and quantity of denaturant present and whether the alcohol is mixed with water. In most cases, ethyl alcohol or its solutions can be easily ignited under warm ambient temperature conditions. Vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers have some potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.6 pounds per gallon when relatively pure.

Ethyl alcohol does not react with water and many common materials and is stable in normal transportation. It reacts with numerous chemicals, however, and reactions with hydrogen peroxide, bromine pentafluoride, calcium hypochlorite, mercuric nitrate, nitric acid, metal perchlorates, perchloric acid, certain permanganates sodium, potassium, silver nitrate, sodium hydrazide, or similar substances may be explosive. The product is generally considered to be of low toxicity. Products of combustion may include carbon monoxide. (Note: Properties given below mostly for the anhydrous alcohol.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Fully soluble

Solubility in Other Chemicals: Soluble in acetone, benzene, chloroform, ether, methyl alcohol, and most other organic solvents.

Specific Gravity (Liquid): 0.79 at 68°F (20°C)

Boiling Point: 172.9-173.3°F (78.3-78.5°C) at 1 atm.

Melting Point: -169.6 To -179.1°F (-112 to -117.3°C)

Freezing Point: -173.2°F (-114°C)

Molecular Weight: 46.07

Heat of Combustion: -6425 cal/g

Vapor Pressure: 40 mm Hg (0.773 psia) at 66.2°F (19°C)

Flash Point: 55°F (12.8°C), closed cup; 60-64°F (15.6-17.8°C), open cup.

Autoignition Temperature: 685-793°F (353-423°C)

Burning Rate: 3.9 mm/minute

Stability: Stable

Corrosiveness: May react with hot aluminum

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with strong oxidizers, hydrogen peroxide, acetyl chloride, bromine pentafluoride, calcium hypochlorite, chlorine oxides, chromic anhydride, chromyl chloride, mercuric nitrate, silver nitrate, nitric acid, metal perchlorates, perchloric acid, hot aluminum, permanganates treated with sulfuric acid, permanganic acid sodium, potassium, potassium tert-butoxide, and sodium hydrazide.

IDENTIFICATION

Shipping Names: Ethanol or Ethyl alcohol (USDOT and IMO)

Synonyms and Tradenames: Ethanol, ETOH, denatured alcohol, anhydrous ethanol, ethyl hydrate, ethyl hydroxide, fermentation alcohol, methylcarbinol, molasses or potato or grain alcohol; spirits of wine; cologne spirits; Algrain; Anhydrol; Jaysol S; Tescol; Filmcol; Neosol; Padiscol.

Chemical Formula: CH_3CH_2OH

Constituent Components(% each): Anhydrous or various concentrations in water; may contain some amount of denaturant.

UN/NA Designation: UN1170; NA 1986 (USDOT, Denatured alcohol)

IMO Designation: 3.2 or 3.3, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Characteristic; ethereal; like wine or whiskey. Denatured product may be unpleasant.

Common Uses: Used as solvent and for making chemicals, dyes, pharmaceuticals, elastomers, detergents, cleaning preparations, coatings, cosmetics, explosives, antifreeze, beverages, antisepsis, gasohol, plastics, mouthwash, perfumes, inks, paints, lubricants, and other products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYL ALCOHOL

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies widely.

Unusual Hazards: Flammable alcohol of relatively low toxicity. Denatured alcohol is unfit for human consumption.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 1000 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; excessive inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: High concentrations of ethyl alcohol vapors in air may cause eye and nose irritation or symptoms of alcohol intoxication. Special concern must be given to the toxic effects of specific denaturants that may be present in the product.

Hazards of Skin or Eye Contact: Contact of liquid ethyl alcohol with the skin may cause drying and cracking due to the defatting action of the substance. Contact with the eyes may cause irritation and temporary injury.

Hazards of Inhalation: Concentrations of 5000 ppm or more in air may cause transient eye and nose irritation as well as coughing. Very high levels may cause headache, drowsiness, tremors, fatigue, dizziness, and narcosis. Denaturants may produce additional toxic effects.

Hazards of Ingestion: Ingestion of pure ethyl alcohol or its solutions produces the typical effects of alcohol intoxication. Any denaturants present may produce additional toxic effects.

FIRE HAZARDS

Lower Flammable Limit: 3.3%

Upper Flammable Limit: 18.9-19%

Behavior in Fire: Flammable liquid. Vapors may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Carbon monoxide

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire. Contact with various chemicals may result in formation of explosive mixtures. See general information section.

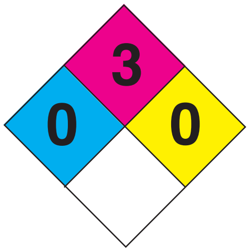
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, polyurethane, Viton, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1170

ETHYL ALCOHOL
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Eye and nose irritation due to vapors; eye irritation or drying of skin due to direct physical contact; symptoms of alcohol intoxication.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious and less than 2 hours have elapsed since ingestion, administer large quantities of water or baking soda solution and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately, particularly if denaturants are present in the alcohol.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog; alcohol foam, carbon dioxide, dry chemical. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Take into account while planning the response that ethyl alcohol is a somewhat volatile flammable liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Ethyl alcohol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the spill is small or in cold weather.

CONSEQUENCE

Hazardous levels of ethyl alcohol in air may be found in the local spill area and some distance downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to ethyl alcohol vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethyl alcohol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ETHYL ALCOHOL

Class 3 (Flammable Liquid)

TECHNIQUE

ALCOHOL FOAM ... Alcohol or AFFF foam applied to the surface of liquid pools may slow the release of ethyl alcohol vapors into the atmosphere.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid ethyl alcohol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Ethyl alcohol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethyl alcohol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

ETHYL ALCOHOL
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the over all volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users. Contaminated water body may require testing to determine when it is safe to use again, particularly with respect to any denaturants present in ethyl alcohol.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

ETHYLAMINE
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Ethylamine anhydrous is a colorless, flammable, and highly volatile gas with an odor resembling ammonia. It is fully soluble in water and will mix freely.

Any spilled liquid will boil or otherwise rapidly vaporize under most ambient temperature conditions, thus potentially generating large amounts of vapor that may be heavier than air, persist for a time in low areas, or travel a considerable distance to source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. The anhydrous liquid weighs approximately 5.7 pounds per gallon; 70% solutions weigh about 6.6 pounds per gallon.

It does not react with water or many other common materials and is stable in normal transportation. It can be corrosive to a variety of metals, however, and may attack many forms of plastics, rubber, and coatings. Additionally, it is reactive with numerous other chemicals, including strong oxidizing agents and strong acids. The substance and its vapors are highly corrosive to bodily tissues and their toxic hazard must be considered high by all possible routes of exposure. Products of combustion are reported to include irritating, corrosive, and/or toxic substances such as ammonia, carbon monoxide, carbon dioxide, very highly toxic oxides of nitrogen, and possibly other harmful substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if ethylamine is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in acetone, dimethyl sulfoxide, ether, ethyl alcohol, and many other organic solvents.

Specific Gravity (Liquid): 0.683 for anhydrous; 0.797 for 70% aqueous solution; both at 68°F (20°C).

Boiling Point: 61.7 - 62.6°F (16.5 - 17°C) for anhydrous; 100 – 107.6°F (37.8 - 42°C) for 70% aqueous solution; both at 1 atm.

Melting Point: -114.2 to - 112°F (- 81.2 to - 80°C) for anhydrous; values for 70% solution vary widely from - 76°F (- 60°C) to less than - 130°F (- 90°C).

Freezing Point: See melting point.

Molecular Weight: 45.08 for ethylamine.

Heat of Combustion: - 8,990 cal/g.

Vapor Pressure: 873 - 912 mm Hg (16.87 - 17.63 psia) at 68°F (20°C); and 1520 mm Hg (29.38 psia) at 96.3°F (35.7°C) for anhydrous. Reported values vary widely for 70% solutions at 68°F (20°C).

Flash Point: At or below 0°F (- 17.8°C), for anhydrous product or 70% aqueous solution.

Autoignition Temperature: 723 - 725°F (384 - 385°C) for anhydrous.

Burning Rate: 5.0 mm/minute for anhydrous.

Stability: Stable.

Corrosiveness: Anhydrous reported as not compatible with aluminum, copper, and silver; will strip and dissolve paint, dissolve most plastics, and cause swelling of rubber. Aluminum, copper, tin, lead, zinc and many of their alloys (such as brass, galvanized metals, etc) are attacked by moist ethylamine; 70% solution is reported as not compatible with aluminum, brass, bronze, copper, galvanized iron, polyethylene, rubber, and zinc. Iron, steel, stainless steel, steel reinforced neoprene lines, and fittings with lead or asbestos composition gaskets are reported compatible with anhydrous. Mild steel, stainless steel, and tinned iron reported suitable for 70% solutions.

Reactivity with Water: No reaction; anhydrous ethylamine dissolves (possibly with some generation of heat) to form a strongly alkaline solution.

Reactivity with Other Chemicals: Contact of ethylamine with cellulose nitrate of high surface area may lead to charring. Contact with mercury may result in an explosion. Violent reactions may occur with strong acids or oxidizers. Chlorine or hypochlorites react in a highly exothermic fashion and may form toxic and explosive chloramines. Contact of the similar diethylamine with nitrites or other nitrosating agents can form potent carcinogens and may explode or form explosive compounds in reactions with dicyanofurazan, dicyanofuroxan or 4-chloroacetophenone. Aliphatic amines such as ethylamine generally evolve heat in reactions with aldehydes, non-oxidizing mineral acids, or organic acids; generate heat and toxic gases in reactions with oxidizing mineral acids, halogenated organics, or organic peroxides or hydroperoxides; evolve heat and flammable gases in reactions with alkali or alkaline earth elemental metals or strong reducing agents; generate heat, toxic gases, and fire in reactions with strong oxidizing agents; generate heat and cause violent polymerization of epoxides or isocyanates; and may possibly react in a hazardous fashion with dithiocarbamates.

IDENTIFICATION

Shipping Names: Ethylamine

Synonyms and Tradenames: Aminoethane; 1-aminoethane; EA; ethanamine; 1-ethanamine; ETN; n-ethylamine; and MEA.

Chemical Formula: $CH_3CH_2NH_2$

Constituent Components (% each): Anhydrous (i.e., water-free) product is generally 98.5% or more pure. Solutions commonly contain 33 - 72% ethylamine by wgt.

UN/NA Designation: UN1036 (anhydrous); UN2270 (aqueous solution).

IMO Designation: 2.1, flammable gas, for anhydrous ethylamine.

Physical State As Shipped: Liquid

Physical State As Released: Liquid, boiling liquid, gas, or mixture of gas and aerosols.

Color of the Shipped Material: Colorless liquid or gas

Odor Characteristics: Sharp, pungent, like ammonia.

Common Uses: Making dyes, pharmaceuticals, synthetic resins, detergents, pesticides, and other chemicals; stabilizer for rubber latex; solvent; plasticizer; curing agent for epoxy resins.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ETHYLAMINE
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Lowest reported odor threshold is 0.026 ppm. The sense of smell may become fatigued with time such that odor may not remain a reliable warning property.

Unusual Hazards: Highly flammable material, vapors are heavier than air and may travel to a source of ignition and/or persist in low areas.

Short Term Exposure Limit (STEL): *15* ppm for *15* minutes has been proposed by the ACGIH and may be adopted sometime after 1993. (ACGIH, 1992 - 93).

Time Weighted Average (TWA) Limit: *10* ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989). ACGIH has proposed a 5 ppm TWA that may be adopted sometime after 1993.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the extremely high concentrations of ethylamine vapors that may be present in air at the spill site and over considerable downwind distances. Direct contact and ingestion should also be strictly avoided.

Hazards of Shin or Eye Contact: By analogy to similar amines, prolonged or repeated exposure of the eyes to ethylamine vapor concentrations in air too low to cause other effects may possibly cause blue hazy vision and the appearance of halos around lights due to eventual swelling of eye tissues. The eyes usually return to normal the next day in such cases but intense exposures may require several days for recovery and entail discomfort and sensitivity to light. Contact of the eyes with liquid ethylamine, mists, or concentrated vapors may rapidly result in redness, intense pain, corneal opacities, chemical burns, and possibly permanent blindness. Aqueous solutions containing as little as 1% of the similar diethylamine by weight are known to have caused corneal opacities in animal experiments. Brief contact of the skin with liquid ethylamine or its concentrated vapors may cause various degrees of skin irritation, pain, inflammation, and/or burns. Prolonged contact, especially if covered as with wet clothing, may result in blisters, extensive burns, tissue destruction, and/or deep scarring. Prolonged or repeated contact with similar amines is reported capable of resulting in allergic sensitization of the skin. Prolonged or widespread contact may result in the absorption of harmful amounts of ethylamine through the skin. All exposures should be treated on an emergency basis without delay. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Mists or vapors of ethylamine are reported as irritating and corrosive to the eyes, nose, throat, and lungs at levels as low as 50 ppm. More severe exposures are reported to cause headache, inflammation of the nose and throat, sneezing, laryngeal edema, coughing, chest pain, shortness of breath, difficult breathing, faintness, anxiety, bronchitis, nausea, lung injury, liver and/or heart injury, and possibly death. Severe exposures that are initially survived may result in pulmonary edema and chemical pneumonitis that may be delayed in onset and which may have severe consequences. Exposure to 3000 ppm in air for 4 hours was lethal to at least some rats in one laboratory experiment. In another, 2 of 6 rats died after exposure to 8000 ppm for 4 hours. The NIOSH IDLH (1990) for ethylamine vapors is 4000 ppm. Concentrations of ethylamine vapors directly over a pool of the relatively pure liquid are approximately 526,315 ppm at 35.6°F (2°C). At or above its boiling point, the liquid evolves vapors consisting of 100% ethylamine. Concentrations of ethylamine vapors above a 70% solution may range from 427,630 to 592,100 ppm at 68°F (20°C).

Hazards of Ingestion: Ingestion of liquid ethylamine is reported to result in severe burns of the mouth, throat, stomach and digestive tract, possible hemorrhages in the stomach wall, severe abdominal pain, collapse, and possibly death. Single oral dosages of 290 to 560 milligrams of ethylamine per kilogram of body weight are reported as being fatal to 50% of mice and rats in laboratory experiments.

FIRE HAZARDS

Lower Flammable Limit: 3.5%.

Upper Flammable Limit: 13.9 -14%.

Behavior in Fire: Flammable gas. May generate large quantity of flammable and toxic/corrosive vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently and possibly rocket in a fire.

Hazardous Combustion Products: Not well-defined; may include toxic and/or irritating gases and fumes such as ammonia, carbon monoxide, carbon dioxide, very highly toxic oxides of nitrogen, and possibly other harmful substances.

EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently and possibly rocket in a fire. Explosion may occur if vapors or gases are ignited in a confined area. Contact with certain other chemicals may result in an explosion.

1036

ETHYLAMINE
Division 2.1 (Flammable Gas)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product or its solutions. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high gas or vapor concentrations in air. Clothing providing thermal protection may be required where very cold product or equipment may be contacted. Chemically compatible materials may include butyl rubber, Teflon, and nitrile rubber (not as good as other choices). Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: For unknown concentrations, fire fighting, general use, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister (500 ppm or less) or a chemical cartridge respirator with a full facepiece (500 ppm or less) may be adequate within the use limitations of these devices when equipped with canisters or cartridges providing appropriate protection against ethylamine.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, shortness of breath, pain, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If the nose and throat are irritated due to inhalation and the victim is conscious, flush them with water for 15 minutes. If conscious and able to swallow, encourage victim to drink large quantities of 0.5% citric acid solution or lemonade to further treat the throat. Do not administer alcoholic stimulants.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes (a period of 30 - 60 minutes may be more appropriate), occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing. A major maker of the product says not to apply eye pads or pressure since this may cause "gluing" of the eyelids to the eyeball; 2 - 3 drops of a 0.5% pontocaine solution is permitted to relieve pain, after the relief of which the eyes should be flushed with water or a 0.9% sodium chloride solution. The same source suggests rinsing the skin with vinegar or a 1 to 2% acetic acid solution after washing with water. The use of ointments or coverage of the injured area with clothing or a dry dressing is discouraged during the first 24 hour period. Instead, it is reported that the area may be covered with a dressing kept moist with a 0.9% sodium chloride solution. Where and if necessary, thaw any clothing frozen to the skin before its removal.

First Aid for Ingestion: Get medical attention immediately. If conscious, have victim wash out mouth with water (which should not be swallowed). If medical attention is not immediately available and victim is conscious, administer large quantities of water. Do not attempt to make the victim vomit. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs and repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol foam, water spray. Water may be ineffective but application of large quantities may dilute spills to nonflammable mixtures.

Extinguishing Techniques: Unusual corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk at high ambient temperature. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire. Note that ethylamine cylinders do not have safety pressure relief devices so extra precautions are needed to prevent cylinder explosions due to overexposure to heat or fire. A major maker of ethylamine recommends that water not be applied to leak areas.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent

ETHYLAMINE
Division 2.1 (Flammable Gas)

SPILL RESPONSES (CONTINUED)

substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use. Take the corrosiveness, high flammability, high volatility, and toxic characteristics of ethylamine into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Ethylamine discharges may expose downwind areas to toxic and flammable concentrations over very considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethylamine vapors or aerosols may absorb vapors, knockdown aerosols, and/or accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethylamine from contact with its vapors or aerosols.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of ethylamine vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam application until spilled liquid is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid ethylamine and its solutions may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Neutralize and/or remove liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Neutralize and/or remove liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ETHYLAMINE
Division 2.1 (Flammable Gas)

LAND SPILL *(CONTINUED)*

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Any remaining ethylamine on the ground will vaporize fairly quickly at most temperatures.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Due to its relatively low boiling point, high pressures may develop very rapidly in recovery equipment at moderate to high ambient temperatures if anhydrous ethylamine is being recovered.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as carbon dioxide or nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates when equipment temperatures exceed the boiling point of the liquid to be recovered. Consult qualified experts as necessary for assistance.

TECHNIQUE

ABSORPTION . . . Where ambient temperature conditions permit and/or require, spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe and appropriate storage containers by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Where necessary, contaminated soil and/or product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors *present in* the area may be ignited by motorized equipment.

MITIGATION

Decontaminate all equipment after use as necessary, keeping the volatility of ethylamine in mind. Use equipment compatible with spilled product. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Any spilled ethylamine will quickly dissolve in water and form a strongly alkaline solution. Be advised that potentially toxic and flammable vapors may evolve from the water surface for a time and travel in the downwind direction as the contaminated water moves downstream.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ETHYLAMINE
Division 2.1 (Flammable Gas)

WATER SPILL *(CONTINUED)*

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Cation exchangers may be effective for use on sufficiently diluted neutral or acidic solutions.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance-in obtaining and deploying necessary equipment. Apply alternative techniques where sir emissions may pose a downwind hazard.

January 1990

ETHYL BENZENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl benzene is a clear, colorless liquid hydrocarbon of relatively low volatility and with an aromatic, pungent, and sweet odor resembling gasoline. It is used for making styrene, synthetic rubber, and other chemical substances and as a component of paint, agricultural sprays, gasoline, and asphalt. Practically insoluble in water and lighter, ethyl benzene will form a floating surface slick. Its flash point of 59°F indicates that the product is easily ignited under many ambient temperature conditions. Vapors may be slightly heavier than air in hot weather and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.2 pounds per gallon.

Ethyl benzene does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials, however, and may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low to moderate. Products of combustion may include toxic constituents.

If ethyl benzene is leaking (not on fire), downwind evacuation should be considered on a case by case basis until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.015 to 0.020 g/100 g water (150–200 ppm) in range of 68–86°F (20–25°C).

Solubility in Other Chemicals: Soluble in alcohol, benzene, ether, and carbon tetrachloride.

Specific Gravity (Liquid): 0.867 at 68°F (20°C)

Boiling Point: 277.2°F (136.2°C) at 1 atm.

Melting Point: –139°F (–95°C)

Freezing Point: See melting point

Molecular Weight: 106.17

Heat of Combustion: –9877 cal/g

Vapor Pressure: 7 mm Hg (0.1353 psia) at 68°F (20°C)

Flash Point: 59°F (15°G`), closed cup; 80°F (26.7°C), open *cup*

Autoignition Temperature: 810°F (432°C)

Burning Rate: 5.8 mm/minute

Stability: Stable

Corrosiveness: Specific data unavailable; not expected to be corrosive to common metals in short-term service; may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react or ignite in contact with strong oxidizing agents.

IDENTIFICATION

Shipping Names: Ethyl benzene (USDOT); ethylbenzene (IMO)

Synonyms and Tradenames: Ethyl benzol; phenylethane; EB

Chemical Formula: $C_6H_5\text{-}CH_2CH_3$

Constituent Components (% each): Various grades of 99% or more purity with remainder consisting of other hydrocarbons, including traces of toluene, xylenes, cumene, and diethylbenzene.

49 STCC: 49 091 63

UN/NA Designation: UN1175

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sweet; like gasoline; aromatic;. pungent

Common Uses: Mfg. styrene, cellulose acetate, synthetic rubber, and other chemicals; component or solvent in paint, agricultural sprays, gasoline, and asphalt.

ETHYL BENZENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

***Threshold Odor* Concentration:** 0.25–2.3 ppm in air; reported values vary.
Unusual Hazards: Flammable liquid of relatively low volatility that may evolve slightly heavier than air vapors at higher ambient temperatures.
Short Term Exposure Limits (STEL): 125 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 100 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct-physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the vapor concentrations that may be present in the immediate spill area and over some distances downwind. Ingestion and direct physical contact are also to be avoided.
Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid ethyl benzene may result in drying and cracking of the skin due to the defatting action of the product and also cause moderate redness, swelling, blistering, and chapping. Some small amounts may be absorbed through the skin. Contact of liquid ethyl benzene with the eyes may cause slight irritation and possibly slight (and reversible) corneal injury. Do not wear contact lenses when working with ethyl benzene.
Hazards of Inhalation: Exposure to ethyl benzene vapors in air may cause irritation of the eyes, nose, throat, and respiratory tract that is strong at 1000 ppm in air and intolerable at 2000 ppm. Inhalation of higher concentrations in air may cause narcosis and central nervous system depression with symptoms including weakness, dizziness, drowsiness, headache, cramps, sense of chest constriction, incoordination, unconsciousness, tremors, and possibly death due to respiratory system paralysis in severe cases. Exposure to 4000 ppm for four hours was lethal to 50% of rats, while 9150 ppm was lethal to mice after two hours in laboratory experiments. Guinea pigs who died when exposed to 5000 to 10,000 ppm for eight hours were found to have lung edema and congestion, intense cerebral congestion, and cyanotic blood. (Note: The saturated vapor concentration of ethyl benzene in air is about 9210 ppm at 68°F and 15,790 ppm at 86°F. Vapors will be diluted with air fairly rapidly as they move away from the spill site.)
***Hazards of* Ingestion:** Ethyl benzene is of relatively low oral toxicity. Symptoms of ingesting significant amounts resemble those of inhalation but also include gastrointestinal irritation. Aspiration into the lungs during vomiting, as is the case with many other hydrocarbons, may cause pulmonary edema, chemical pneumonia, lung hemorrhage, and respiratory paralysis with possibly severe consequences. Some effects may be delayed in onset.

FIRE HAZARDS

Lower Flammable Limit: 1.0%
Upper Flammable Limit: 6.7–6.8% according to most; one source gives 5.3%
Behavior in Fire: Flammable liquid. May generate flammable vapors upon release. Vapors may be somewhat heavier than air when the spilled liquid is warm or hot and may travel some distance to a source of ignition and flash back. Containers have some limited potential to rupture violently in fires.
Hazardous Combustion Products: Not well-defined; said to be acrid and irritating and to contain carbon monoxide and carbon dioxide. Likely to contain various hydrocarbons that may be toxic.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. There is a limited potential that containers may rupture violently in fire.

1175

ETHYL BENZENE
Class 3 (Flammable Liquid)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include Viton/nitrile rubber and Teflon according to one noted authority. Another source reports that polypropylene, Viton, neoprene, and Teflon are resistant materials.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (2000 ppm or less) or a chemical cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, respiratory tract or skin; symptoms of narcosis and central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, Halon, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl benzene may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that ethyl benzene is a flammable liquid.

ETHYL BENZENE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl benzene spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm or hot weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Ethyl benzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cool or cold weather.

CONSEQUENCE

Hazardous levels of ethyl benzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl benzene vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of ethyl benzene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of ethyl benzene vapors into the atmosphere.

CONSEQUENCE ,

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethyl benzene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethyl benzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ETHYL BENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, vermiculite, fly ash, cement powder, perlite, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Even very low concentrations of ethyl benzene in water can be harmful to aquatic life.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

ETHYL BENZENE
Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating ethyl benzene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with ethyl benzene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ETHYL CHLORIDE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Ethyl chloride is a clear colorless highly volatile liquid that boils at the relatively low temperature of 54°F and has a pungent odor resembling ether. It is used as an anesthetic, solvent, refrigerant, insecticide, and feedstock for making various other chemicals and products. It is slightly soluble in water and lighter, so may be expected to form a floating surface slick that boils in warm weather or otherwise evaporates rapidly while slowly dissolving in water. Its lowest reported flash point of -45°F indicates that it may be easily ignited under all ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions, if ignited, and there is also some known potential for explosions involving unconfined vapor clouds. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.5 pounds per gallons.

Ethyl chloride does not react with water or many other common materials and is stable in normal transportation. It is reactive with various chemicals, however, and may attack some forms of plastics, rubber, and coatings. It is of low to moderate toxicity by the various routes of exposure but may be present in air in high concentrations. Products of combustion may include toxic gases such as hydrogen chloride, phosgene, and carbon monoxide.

Downwind evacuation should be considered if ethyl chloride is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.57 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol and ether.

Specific Gravity (Liquid): 0.904 at 59°F (15°C)

Boiling Point: 54°F (12.2°C) at 1 atm.

Melting Point: -217.7°F (-138.7°C)

Freezing Point: -217.7°F (-138.7°C)

Molecular Weight: 64.52

Heat of Combustion: -4500 cal/g

Vapor Pressure: 1.4 atm (20.6 psia) at 68°F (20°C)

Flash Point: -58°F (-50°C), closed cup; -45°F (-42.8°C), open cup.

Autoignition Temperature: 966°F (518.9°C)

Burning Rate: 3.8 mm/minute

Stability: Stable but may hydrolyze slowly in water.

Corrosiveness: May attack some forms of plastics, rubber, and coatings; may react with powdered aluminum, zinc, and magnesium.

Reactivity with Water: No reaction normally. May react with very hot water or steam to produce toxic fumes.

Reactivity with Other Chemicals: Reacts with oxidizing materials and chemically active metals like sodium, potassium, calcium, powdered aluminum, zinc, and magnesium.

IDENTIFICATION

Shipping Names: Ethyl chloride (USDOT and IMO)

Synonyms and Tradenames: Chloroethane; monochloroethane; hydrochloric ether; muriatic ether; monochlorethane; aethylis; aethylis chloridum; anodynon; chelen; chlorene; chlorethyl; chloridum; chloryl; chloryl anesthetic; cloretilo; dublofix; ether chloratus; kelene; nar cotile.

Chemical Formula: C_2H_5Cl

Constituent Components(% each): 98-100% pure

UN/NA Designation: UN1037

IMO Designation: 2.1, flammable gas

Physical State as Shipped: Liquid

Physical State as Released: Liquid (boils at 54°F)

Color of the Shipped Material: Colorless

Odor Characteristics: Sweet, pungent, like ether

Common Uses: Anesthetic; solvent; refrigerant; insecticide; aerosol propellant; mfg. of dye, drugs, perfumes, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYL CHLORIDE
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Extremely volatile flammable liquid with heavier than air vapors. May boil at 54°F and above. Vapors may persist in pits, hollows, and depressions.

Short Term Exposure Limits(STEL): 1250 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 1000 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air. Direct contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with liquid ethyl chloride may result in frostbite due to rapid evaporation of the product, and some amount of liquid may be absorbed through the skin. Contact with the eyes or skin may also cause mild irritation.

Hazards of Inhalation: Ethyl chloride vapors are narcotic and cause central nervous system depression at high concentrations. Symptoms include dizziness, eye irritation, abdominal cramps, talkativeness, incoordination, inebriation, headache, and eventual loss of consciousness with possible injury to the lungs, liver, and kidneys. Sudden deaths have occurred, probably due to respiratory or cardiac arrest. A concentration of 13,000 ppm causes slight symptoms of inebriation in 12 minutes.

Hazards of Ingestion: Ingestion of ethyl chloride is considered unlikely but symptoms may include those described above.

FIRE HAZARDS

Lower Flammable Limit: 3.6-3.8%

Upper Flammable Limit: 12-15.4%

Behavior in Fire: Flammable liquid. Will generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. There is a known potential for unconfined vapor clouds to explode if ignited.

Hazardous Combustion Products: May include toxic hydrogen chloride, phosgene, and carbon monoxide gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

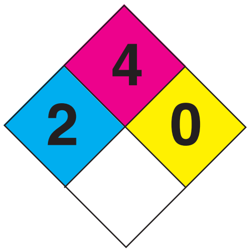
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1037

ETHYL CHLORIDE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Frostbite, eye or skin irritation; symptoms of central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation is present after washing. Do not use hot water for flushing.

First Aid for Ingestion: If victim is conscious, induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Stop flow if possible or let large fires burn while cooling surroundings.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl chloride may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile and flammable nature of ethyl chloride into account when planning the response. Note that accumulations of heavy gas may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl chloride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYL CHLORIDE

Division 2.1 (Flammable Gas)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to ethyl chloride vapors or fumes may accelerate their dispersal in the atmosphere. If water is warm, apply it at a point downwind and do not allow it to contact liquid ethyl chloride as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of ethyl chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM ... Firefighting foam applied to the surface of liquid pools may slow the release of ethyl chloride vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Ethyl chloride may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethyl chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

ETHYL CHLORIDE
Division 2.1 (Flammable Gas)

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: Floating ethyl chloride will rapidly evaporate from the water surface under most conditions. Oil spill containment and cleanup methods may be necessary and useful in cold weather.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ETHYL CHLORIDE

Division 2.1 (Flammable Gas)

TECHNIQUE

ADSORPTION ... Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ETHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Ethyl chloroformate is a colorless to light yellow flammable liquid with an irritating, pungent, and sharp odor resembling hydrochloric (muriatic) acid. It is used for making pharmaceuticals, herbicides, plastics, and a variety of other chemical products. The substance is slightly heavier than water, slightly soluble, and slowly reactive, so may be expected to sink slowly while simultaneously reacting to form ethyl alcohol and hydrochloric acid. Its flash point indicates it may be easily ignited under a wide range of ambient temperature conditions. Vapors may travel some distance to a source of ignition and flash back, particularly at warmer temperatures. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 9.5 pounds per gallon.

Ethyl chloroformate is relatively stable in normal transportation except for a tendency to decompose slowly to hydrogen chloride and ethyl alcohol. It is reactive with a variety of other chemicals, certain types of metals and rubber, and certain metallic rusts and salts. Any hydrochloric acid formed will be corrosive to most metals and may cause evolution of flammable and potentially explosive hydrogen gas during the corrosion process. The corrosivity of ethyl chloroformate itself to bodily tissues is high and requires that all contact with the product be strictly avoided. Products of combustion are both toxic and corrosive and may include chlorine, phosgene, hydrochloric acid, chloroformate fumes, and carbon monoxide.

If ethyl chloroformate is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL PHYSICAL DATA

Solubility in Water: Practically insoluble; reacts slowly (see below).

Solubility in Other Chemicals: Soluble in benzene, chloroform, and ether.

Specific Gravity (Liquid): 1.135 – 1.139 at 68°F (20°C)

Boiling Point: 199.4 – 203°F (93 – 95°C) at 1 atm.

Melting Point: –113.1°F (– 80.6°C)

Freezing Point: See melting point

Molecular Weight: 108.5

Heat of Combustion: – 3800 cal/g (est.)

Vapor Pressure: 32 or 53 mm Hg at 68°F (20°C); reported values vary.

Flash Point: Most give 61°F (16.1°C), closed cup; 82°F (27.8°C), open cup. Some say 36°F (2.2°C).

Autoignition Temperature: 932°F (500°C)

Burning Rate: 2.6 mm minute

Stability: Stable in normal transportation except for possible slow decomposition to hydrogen chloride and ethyl alcohol.

Corrosiveness: Any hydrochloric acid formed will be corrosive to most metals, particularly iron and aluminum, with evolution of hydrogen gas. Best handled in glass, lead, porcelain, tantalum, high density polyethylene, furans, polypropylene, or teflon. Related products are known to attack certain types of rubber.

Reactivity with Water: Reacts slowly to produce flammable ethyl alcohol and corrosive hydrochloric acid (also known as muriatic acid) or hydrogen chloride while generating heat.

Reactivity with Other Chemicals: Incompatible with oxidizing agents, alkali or caustics, acids, alcohols, amines, certain types of rubber, certain metals, and rust. Iron, zinc, and aluminum salts may catalyze decomposition, possibly explosively.

IDENTIFICATION

Shipping Names: Ethyl chloroformate (USDOT and IMO)

Synonyms and Tradenames: Chloroformic acid, ethyl ester; ethyl chlorocarbonate; carbonochloridic acid, ethyl ester.

Chemical Formula: $ClCOOCH_2CH_3$

Constituent Components (% each): 94% or more pure; remainder may include small amounts of hydrochloric acid, ethyl alcohol, and diethyl carbonate.

UN/NA Designation: UN1182

IMO Designation: 6.1 Poisonous Substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless to light yellow

Odor Characteristics: Irritating; sharp; like muriatic acid; pungent

Common Uses: Making of flotation agents, isocyanates, pharmaceuticals, herbicides, plastics, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ETHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly flammable and corrosive liquid. Reacts with water to form ethyl alcohol and hydrogen chloride or hydrochloric acid.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the relatively high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Ethyl chloroformate is considered to be corrosive and destructive to living tissue. Contact with the skin or eyes may cause severe acid-type burns. Vapors of the product are irritating to the eyes and cause tears at low concentrations in air.

Hazards of Inhalation: Vapors of ethyl chloroformate are highly irritating to the respiratory tract. Inhalation may cause burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting, choking, chest pain, edema of the larynx and bronchi, chemical pneumonitis, pulmonary edema (which may be delayed in onset), and possibly death. Exposure to 145 ppm in air for one hour was fatal to 50% of rats in laboratory experiments. A level of 510 ppm was the lowest concentration causing fatalities in mice within 10 minutes.

Hazards of Ingestion: Moderately toxic when ingested and may cause severe burns of the mouth, throat, and stomach leading to death. Similar materials cause stomach pain, nausea, vomiting, and esophageal or gastric necrosis.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquid. Vapors may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire due to overheating and or product decomposition. Will generate large quantities of flammable and corrosive gas or vapor upon release.

Hazardous Combustion Products: Toxic and corrosive; may include chlorine, phosgene, carbon monoxide, hydrochloric acid, and chloroformate fumes.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Note that some chloroformates may explode due to pressure or catalysis.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with ethyl chloroformate. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1182

ETHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

FIRST AID

Nonspecifc Symptoms: Irritation or burns of any bodily tissues; choking, coughing, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, halon, foam. Note that ethyl chloroformate may react with water. Water or foam should be applied with caution at first.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the corrosive, flammable, reactive, and volatile nature of the product into account when planning the response. Note that sealed containers may contain some pressure due to product decomposition.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl chloroformate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities of fumes and vapors are being generated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl chloroformate vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain ethyl chloroformate, hydrochloric acid, and ethyl alcohol from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of hazardous vapors or fumes into the atmosphere. (Note: Since foam is recommended for firefighting, it may also be beneficial for this purpose. Due to the potential reactivity of the product, apply foam with caution at first. Be advised that various authorities disagree on whether alcohol or regular foam should be used.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to contained liquid ethyl chloroformate may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid ethyl chloroformate and its products of reaction with water may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ETHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

TECNNIQUE

PUMPING /VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of liquids may be controlled by absorbing liquid with dry sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ETHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

ETHYLENE
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Ethylene is a colorless gas shipped as a compressed or liquefied gas and having a faint, slightly sweet, ethereal odor. It is used for welding and cutting metal, ripening fruits and vegetables, as an anesthetic, and for making plastics and organic chemicals. It is practically insoluble in water. With a flash point of about – 213°F and a boiling point of –154.7°F, large amounts of flammable gas will be evolved from spills. The cold gas evolved will initially be heavier than air and may travel very considerable distances to a source of ignition and flash back. Accumulations of gas in confined spaces such as buildings or sewers may result in explosions if ignited, and there is also some known potential for explosions involving unconfined vapor clouds. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 4.7 pounds per gallon at its boiling point.

Ethylene does not react with water or many common materials and is stable in normal transportation. It is, however, reactive with a variety of other chemicals. The gas is not significantly toxic by inhalation, but high concentrations may be anesthetic or may cause asphyxiation via displacement of air. Liquid ethylene and concentrated cold gas also pose a frostbite hazard. Products of combustion may include toxic constituents such as carbon monoxide.

If bulk container is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius one half (½) mile. If cylinder is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of one third (⅓) mile.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble.
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.569 at –154.7°F (–103.8°C)
Boiling Point: –154.7°F (–103.7°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: – 272.4°F (–169.1°C)
Molecular Weight: 28.05
Heat of Combustion: –11272 cal/g
Vapor Pressure: 40 atm (587.6 psia) at 29.3°F (–1.5°C)
Flash Point: –213°F (–136°C), closed cup (approx.)
Autoignition Temperature: 842°F (450°C)
Burning Rate: 7.4 mm/minute
Stability: Stable
Corrosiveness: Noncorrosive
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with chlorine, oxidizing materials, aluminum chloride, benzoyl peroxide and carbon tetrachloride, carbon tetrachloride, nitrogen dioxide, nitromethane and aluminum chloride, ozone, sulfuric acid, and nitric acid.

IDENTIFICATION

Shipping Names: Ethylene (USDOT and IMO); ethylene, compressed (USDOT); ethylene, refrigerated liquid (USDOT)
Synonyms and Tradenames: Ethene; acetene; bicarburretted hydrogen; elayl; olefiant gas; etherin.
Chemical Formula: $H_2C = CH_2$
Constituent Components(% each): 99–100% pure
49 STCC: 49 057 34 (compressed); 49 057 35 (refrigerated liquid)
UNINA Designation: UN1962 (compressed); UN1038 (refrigerated liquid)
IMO Designation: 2.1, flammable gas
Physical State as Shipped: Compressed or liquefied gas
Physical State as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless (gas may appear white at first)
Odor Characteristics: Faint, slightly sweet, pungent, like ether
Common Uses: Welding and cutting metal; ripening fruits and vegetables; anesthetic; mfg. plastics and organic chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYLENE
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 400 ppm

Unusual Hazards: Large amounts of flammable gas may be released during spills and may travel to a source of ignition and flash back. Vapors are heavier than air at first and may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable (simple asphyxiant)

Time Weighted Average (TLV-TWA): Unavailable (simple asphyxiant)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry to sewers or confined spaces; inhalation; contact with cold product or equipment.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high gas concentrations that are likely to be present in the spill area and some distance downwind.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with venting gas or liquid ethylene may result in frostbite.

Hazards of Inhalation: Ethylene gas is a simple nonirritating asphyxiant that may cause death by displacement of air at very high concentrations in air. Moderate concentrations may cause headache, drowsiness, muscular weakness, dizziness, and unconsciousness.

Hazards of Ingestion: Ingestion of ethylene is unlikely. Contact of the liquid with the mouth or throat might cause frostbite.

FIRE HAZARDS

Lower Flammable Limit: 2.75–3.02%

Upper Flammable Limit: 28.6–34%

Behavior in Fire: Flammable compressed or liquefied gas. Will generate large quantities of flammable gas upon release. Gas may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: May include toxic constituents such as carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if gas is ignited in a confined area. There is also some known potential for explosions of unconfined gas clouds. Containers may rupture violently in fire. Product is spontaneously explosive in sunlight with chlorine.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with very cold ethylene or containers. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific symptoms: Frostbite from contact; headache, dizziness, or other symptoms of excessive inhalation.

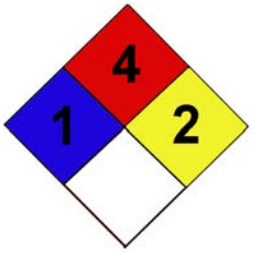
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least *15* minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: Do not use hot water or rub frozen area. Treat for frostbite.)

First Aid for Ingestion: Drink warm water to relieve frostbite. Get medical attention immediately.

1038

ETHYLENE
Division 2.1 (Flammable Gas)



FIRE RESPONSE

Extinguishing Materials: Stop flow of gas if possible. Use carbon dioxide, dry chemical, water fog. High expansion foam may be effective on liquid pools.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with cold product. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to liquid pools of ethylene may increase gas evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent product from entering sewers and confined spaces. Note that intake of ethylene may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Take into account while planning the response that ethylene is extremely volatile and flammable. Pools of liquid will be at –154.7°F. Accumulations of cold heavy gas may persist for a time in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethylene spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethylene vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact pools of liquid ethylene on the ground as this may increase gas evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of ethylene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . High expansion foam applied to the surface of liquid pools may slow the release of ethylene vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations.

ETHYLENE
Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid ethylene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ethylene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Residues will rapidly evaporate.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination where large quantities of liquid ethylene have spilled onto water. Only a very small fraction of the ethylene will dissolve in water. Most will boil off, so this and following responses may only be needed where critical water supplies are impacted.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ETHYLENE
Division 2.1 (Flammable Gas)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTIONN. . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July, 1994

ETHYLENEDIAMINE*
Class 8 (Corrosive Material)

GENERAL INFORMATION

Ethylenediamine is a thick, colorless to yellowish liquid with a strong ammonia-like odor. Vapors are irritating to the respiratory mucous membranes and eyes. It has a freezing point of between 8.5 and 11°C (47.3 to 51.8°F). On reaching temperatures below that point, solutions will tend to solidify. Ethylenediamine's fairly low vapor pressure coupled with its relatively high flash point indicate that the threat of ignition will be largely confined to the vicinity of the actual release. Factors such as increased pool size and increased temperature will promote the generation of vapors. Likewise, the risks of inhalation exposures are likely to be confined to the immediate vicinity of the spill or due to the buildup of vapors in confined spaces. Vapors are heavier than air.

Ethylenediamine is corrosive (owing to its high pH) to skin and is toxic by all routes of exposure. Exposures to vapors, mists and liquids can result in severe burns to the exposed tissues. Repeated skin or inhalation exposures can result in sensitizing the exposed individual. Severe or prolonged exposures may result in systemic toxic effects and effects may be delayed in onset. Ethylenediamine is corrosive to copper and copper alloys. It is completely soluble in water, and weighs approximately 7.5 pounds per gallon.

Ethylenediamine is used in a variety of commercial/industrial processes as a textile lubricant, emulsifying agent, antifreeze inhibitor, and in fungicides. It is also used in the manufacture of chelating agents, dimethyloethylene-urea resins, as a solvent for casein, albumin, and shellac. It is also used as a stabilizer in pharmaceuticals such as injectable aminophylline.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble.

Solubility in Other Chemicals: Soluble in alcohol; slightly soluble in ether.

Specific Gravity (Liquid): 0.899

Vapor Density (Air= 1): 2.1

Boiling Point: 116 to 117°C (240.8 to 242.6°F)

Melting Point: 8.5 to 11°C (47.3 to 51.8°F)

Freezing Point: 8.5 to 11°C (47.3 to 51.8°F)

Molecular Weight: 60.10

Heat of Combustion: – 6830 cal/gm

Vapor Pressure: 10 mmHg @ 21.5°C (70.7°F)

Flash Point: 33.9°C (93.2°F) to 43°C (110°F) CC

Autoignition Temperature: 379.4°C (715°F)

Burning Rate: 2.2 mm/min

Stability: Stable unless mixed with incompatible materials. Not subject to violent polymerization.

Corrosiveness: Corrosive to skin, alkaline, pH of 25% solution = 11.9 @ 25°C (77°F); readily corrodes copper and copper containing alloys.

Reactivity with Water: Not reactive, completely soluble.

Reactivity with Other Chemicals: Reacts violently with acids owing to its high pH. Reacts with aldehydes, ketones and acrylates to generate heat and /or pressure. As with most organics, reacts violently and may ignite in the presence of strong oxidizing agents.

IDENTIFICATION

Shipping Names: Ethylenediamine.

Synonyms and Tradenames: 1,2-diaminoethane; CAS 107-15-3.

Chemical Formula: $NH_2CH_2CH_2NH_2$

Constituent Components (% each): Range from 40 - 60% water/ethylenediamine to 100% ethylenediamine (anhydrous).

UN/NA Designation: UN1604

IMO Designation: 8, corrosive material.

Physical State as Shipped: Thick, viscous liquid.

Physical State as Released: Thick, viscous liquid.

Color of the Shipped Material: Clear, colorless.

Odor Characteristics: Ammonia odor.

Common Uses: Used as a textile lubricant, emulsifying agent, antifreeze inhibitor, and fungicide. It is also used in the manufacture of chelating agents and dimethyloethylene-urea resins. It is a solvent for casein, albumin, and shellac and is an inhibitor in antifreezes. It is also used as a stabilizer in pharmaceuticals such as aminophylline injection.

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[*] Reportable Quantity (RQ) established. Refer to appendix 1.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ETHYLENEDIAMINE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 11.2 ppm (28 mg/m^3)

Unusual Hazards: Ethylenediamine is toxic by all routes of exposure but direct contact is the most likely route. It is a strong irritant and a sensitizing agent. It may act as a contact allergen in sensitive individuals.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): 10 ppm (25 mg/m^3) air, OSHA PEL - TWA

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Toxic by inhalation and skin absorption. Direct contact with ethylenediamine or direct contact with contaminated materials is the most likely route of exposure. It is a strong irritant and a strong sensitizing agent. It may act as a contact allergen in sensitive individuals. There is an increased risk to persons with pre-existing conditions such as asthma and allergies or a known sensitivity to ethylenediamine. It is a moderate fire risk due to its relatively high flash point. Increasing temperatures of liquid will increase fire risk.

Hazards of Skin and Eye Contact: Extremely corrosive to eye tissues. Exposure to vapors may be severely irritating. Exposure to liquid or mists can cause severe corneal damage and corneal edema. Severe exposures may result in permanent eye damage or blindness. May cause severe burns to the skin. It can be absorbed through intact skin on repeated or prolonged exposures. Ethylenediamine is a potent skin sensitizer.

Hazards of Inhalation: May cause irritation to respiratory mucous membranes, coughing, wheezing, nausea, vomiting and dizziness. May aggravate pre-existing respiratory conditions such as asthma or allergies. In sensitized individuals, may elicit an allergic response, such as development of a skin rash or respiratory responses such as wheezing and asthma. Allergic responses will vary depending on the sensitivity of the individual exposed but could become life threatening. Exposure to extremely high concentrations may result in permanent lung damage.

Hazards of Ingestion: May result in severe alkali burns to the throat and mouth depending on the concentration. Gastrointestinal distress, nausea, and vomiting are likely to occur depending on the severity of the exposure.

FIRE HAZARDS

Lower Flammable Limit: 4.2%

Upper Flammable Limit: 14.4%

Behavior in Fire: A moderate ignition risk. Vapor generation is likely to be localized in the vicinity of the spill. Vapors are heavier than air and may ignite and flashback to the source. Vapors may collect in low lying areas and enclosed buildings. Temperature and spill surface area will affect the generation of flammable vapors.

Hazardous Combustion Products: May include ammonia, oxides of nitrogen, oxides of carbon, and unburned product.

EXPLOSION HAZARDS

Explosiveness: *No* specific explosive behaviors identified. Ethylenediamine is not subject to violent polymerization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with ethylenediamine liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully covering or encapsulating suits, made of compatible material are appropriate for most large spill situations. Butyl rubber is an appropriate material of construction.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

1604

ETHYLENEDIAMINE
Class 8 (CORROSIVE MATERIAL)

FIRST AID

Nonspecific Symptoms: Irritation to eyes, localized and transient irritation to skin. Abdominal distress on ingestion and anesthetic effects such as headache and dizziness. On prolonged respiratory exposure symptoms may be accompanied by coughing or wheezing, depending on exposure duration.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible, without increasing eye injury. Flush eyes immediately with clean water for at least 30 minutes, occasionally lifting the eyelid. Seek medical assistance immediately. Risk of permanent eye damage. Prompt medical evaluation is essential. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists.

First Aid for Ingestion: *Do* not induce vomiting. If victim is conscious, give large amounts of water or milk by mouth. Never give anything by mouth to an unconscious person. Provide supportive care and seek medical assistance immediately. Ethylenediamine is highly (alkali) corrosive to mucous membranes. The decision to empty the stomach contents should be made by a physician considering the relative risks from corrosive nature of ethylenediamine. There is no specific antidote.

FIRE RESPONSE

Extinguishing Materials: Water fog, foam, alcohol foam, carbon dioxide, dry chemical.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with ethylenediamine. Wear self contained breathing apparatus and appropriate personal protective clothing. Move intact container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Carbon dioxide, or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam or the application of water fog is appropriate for fires involving ethylenediamine.

SPILL RESPONSES

General Information: Ethylenediamine is corrosive and flammable. Response strategies should account for the fact that vapors are heavier than air and may collect locally in enclosed spaces or low lying areas. Ethylenediamine may solidify at temperatures below the freezing point. When spilled in water, ethylenediamine is completely soluble and will tend to disperse in the water column. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Ethylenediamine may not evolve large amounts of hazardous airborne contaminants in many outdoor situations. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ethylenediamine vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

ETHYLENEDIAMINE
Class 8 (CORROSIVE MATERIAL)

AIR SPILL *(CONTINUED)*

MITIGATION

Remove spilled ethylenediamine as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for ethylenediamine vapor concentrations.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog applied to ethylenediamine vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain a small amount of ethylenediamine from contact with airborne vapors or fumes. Water spray will add to the volume of the spilled material.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of ethylenediamine vapors into the atmosphere. Vapor generation may not be sufficient to warrant foam applications.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with ethylenediamine.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of ethylenediamine liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids or solids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Ethylenediamine solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking product.

ETHYLENEDIAMINE
Class 8 (CORROSIVE MATERIAL)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Ethylenediamine solutions may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools or dry solids may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed. Avoid equipment constructed with copper or copper alloys.

TECHNIQUE

ABSORPTION . . . Spilled liquids can be absorbed and immobilized with inert materials such as sand, earth, saw dust, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with ethylenediamine solution and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL. . . Ethylenediamine contaminated soil and solidified ethylenediamine may be removed by shovels, motorized graders, scrapers, loaders, buldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Avoid equipment constructed with copper or copper alloys. Store contaminated materials in a safe and secure location.

ETHYLENEDIAMINE
Class 8 (CORROSIVE MATERIAL)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

March 1995

ETHYLENE DIBROMIDE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Ethylene dibromide is a colorless nonflammable solid or liquid with a melting point of 48.2 – 50°F and a sweetish faintly nauseating odor like chloroform. It is used in gasoline and in waterproofing preparations, as a solvent, in fire extinguishers and gauge fluids, and in making other chemicals. It is slightly soluble in water and heavier so may be expected to sink and dissolve slowly. The liquid product weighs approximately 18.2 pounds per gallon.

Ethylene dibromide does not react with water or many other common materials. It is stable in normal transportation but may decompose at high temperatures or in the presence of light. The product reacts, possibly vigorously or violently, with strong oxidizing agents, strong alkalies, active metals, or liquid ammonia. Toxicity of the substance is moderate to high by the various routes of exposure and it is a suspected human carcinogen. At high temperatures, or in contact with hot metal, ethylene dibromide may decompose to highly toxic and or irritating gases such as hydrogen bromide, bromine, and carbon monoxide.

Downwind evacuation should be considered on a case by case basis if ethylene dibromide is leaking from its container until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.4 – 0.43g/l00g water at 86°F (30°C)
Solubility in Other Chemicals: Soluble in alcohol, ether, and most other solvents and thinners.
Specific Gravity (Liquid): 2.17 – 2.18 at 68°F (20°C)
Boiling Point: 267.8 – 269.6°F (131–132°C) at 1 atm.
Melting Point: 48.2 – 50°F (9 –10°C)
Freezing Point: See melting point
Molecular Weight: 187.88
Heat of Combustion: Not flammable
Vapor Pressure: Approximately 8.6 – 9.0 mm Hg (0.166 – 0.174 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable in normal transportation; slowly decomposes in presence of light.
Corrosiveness: May attack some forms of plastics, rubber, greases, and coatings. No appreciable attack on steel.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts vigorously or explosively with strong oxidizing agents; strong alkalies; metals such as powdered aluminum, magnesium, zinc, sodium, potassium, and calcium; or liquid ammonia.

IDENTIFICATION

Shipping Names: Ethylene dibromide (USDOT and IMO)
Synonyms and Tradenames: 1,2-Dibromoethane; sym-dibromoethane; bromofume; glycol dibromide; glycolbromide; EDB; DBE; Dowfume; E-D-Bee; Fumo-gas; Iscobrome D; Kopfume; Nephis; Pestmaster; Soilbrom; Soilfume; Unifume.
Chemical Formula: $BrCH_2CH_2Br$
Constituent Components (% each): Relatively pure (close to 100%)
UN/NA Designation: UN1605
IMO Designation 6.1, poisonous substance
Physical State As Shipped: Liquid
Physical State As Released: Liquid or solid
Color of the Shipped Material: Colorless
Odor Characteristics: Like chloroform; sweetish; faintly nauseating
Common Uses: Lead scavenger in gasoline; general solvent; in waterproofing preparations; in organic synthesis; in fire extinguishers and gauge fluids; formerly used as fumigant.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ETHYLENE DIBROMIDE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at about 10 ppm in air.

Unusual Hazards: Suspected human carcinogen.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable. Listed as suspected human carcinogen by ACGIH. NIOSH recommends 0.13 ppm for 15 minute ceiling limit.

Conditions to Avoid: High heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the relatively high vapor concentrations that may be present in the air in the immediate spill area and downwind. Prolonged contact and ingestion should also be strictly avoided. Note that ethylene dibromide is a suspected human carcinogen and known to cause adverse reproductive effects in animals.

Hazards of Skin or Eye Contact: Prolonged contact of the skin with ethylene dibromide may cause redness, inflammation, blisters, pain, and skin ulcers that may be delayed in appearance. The product may be absorbed through the skin in toxic amounts and may also sensitize the skin. Contact of the eyes with the product may result in pain, irritation, and temporary corneal injury. Do not wear contact lenses when working with ethylene dibromide.

Hazards of Inhalation: Vapors of ethylene dibromide are irritating to the eyes, nose, throat, and lungs. Inhalation of high concentrations in air may cause coughing, difficult breathing, nausea, vomiting, dizziness, faintness, headache, diarrhea, liver and kidney injury, pulmonary edema (which may be delayed in onset), cardiac failure, and possibly death. Exposures to 3000 ppm in air for 6 minutes, 400 ppm for 30 minutes, or 200 ppm for 2 hours were fatal to rats in laboratory experiments.

Hazards of Ingestion: Ethylene dibromide is of moderate to high toxicity via ingestion. Most effects are similar to those of inhalation.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Nonflammable liquid or solid.

Hazardous Combustion Products: Not itself flammable but toxic and irritating gases and fumes are formed upon exposure to high heat or hot metals. These include hydrogen bromide, bromine, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Contact with incompatible powdered metals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

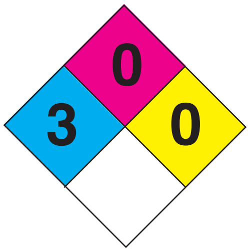
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 400 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (400 ppm or less) or a chemical cartridge respirator with an organic vapor cartridge and full facepiece (400 ppm or less) within the use limitations of these devices.

1605

ETHYLENE DIBROMIDE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues; headache, dizziness, nausea, vomiting, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH recommends that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Ethylene dibromide is not itself combustible. Use water, dry chemical, carbon dioxide, or foam as necessary on surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical-protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethylene dibromide spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large quantities have spilled in a populated area and or have been exposed to heat.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Ethylene dibromide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly when smaller amounts have been discharged or the spill occurs in cold weather.

CONSEQUENCE

Hazardous levels of ethylene dibromide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access of unprotected personnel from the local spill area and areas immediately downwind.

ETHYLENE DIBROMIDE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethylene dibromide vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of ethylene dibromide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that an appropriate firefighting foam applied to the surface of liquid pools may slow the release of ethylene dibromide vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER APPLICATION . . . Application of cold water spray to the surface of contained liquid pools may reduce emissions of vapors or fumes. Since ethylene dibromide is only slightly soluble and heavier than water, cold water will float on the product and possibly cause its solidification.

CONSEQUENCE

Addition of water will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

TECHNIQUE

BURIAL . . . In cool weather, the solidified spilled product may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of vapors or fumes.

CONSEQUENCE

An additional quantity of sand, earth, or similar material will become contaminated. Vapor or fume emissions may continue when the cover material is removed.

MITIGATION

Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethylene dibromide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ethylene dibromide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ETHYLENE DIBROMIDE

Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Solidification of product in cool weather may clog lines or pumps.

MITIGATION

Use equipment compatible with the spilled product. Keep product warm if necessary.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, fly ash, cement powder,commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

ETHYLENE DIBROMIDE
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water and dissolve slowly. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

October 1991

ETHYLENE DICHLORIDE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethylene dichloride is a clear, colorless, oily liquid with a pleasant and sweet odor resembling chloroform or ether. It is used as a fumigant, solvent extractant and raw material for making a wide variety of other chemicals and products. Only slightly soluble in water and heavier, liquid ethylene dichloride may be expected to sink to the bottom of a water body and dissolve at a relatively slow rate. A closed-cup flash point of approximately 55 F indicates that it can be easily ignited under many ambient temperature conditions. At warmer temperatures, vapors may be heavier than air and in any case may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some limited potential for containers of liquid to rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 10.5 pounds per gallon.

Ethylene dichloride does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizers and caustics, chemically active metals and a variety of other chemicals, however, and may attack some forms of plastics, rubber, and coatings. Some of its reactions with other materials may be violent or explosive in nature. Available Information about the corrosivity of ethylene dichloride is not entirely consistent, but it appears that the product may corrode iron and certain other unspecified metals in the presence of water and may react explosively or violently with aluminum, magnesium, or other active metals under appropriate circumstances. Toxicity of the product by all potential routes of exposure is moderate to high. Products of combustion or thermal decomposition are reported to include a number of highly irritating or toxic substances including phosgene.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if ethylene dichloride is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.81 or 0.869g/100g water at 68°F (20°C); reported values vary

Solubility in Other Chemicals: Soluble in alcohol, acetone, benzene, chloroform, ether, and most other common chemical solvents.

Specific Gravity (Liquid): 1.253–1.257 at 68°F (20°C)

Boiling Point: 182.1–182.7°F (83.4–83.7°C) at 1 atm.

Melting Point: –32.3 to –31.5°F (–35.7 to –35.3°C)

Freezing Point: See melting point

Molecular Weight: 98.96

Heat of Combustion: 1887 cal/g (est.)

Vapor Pressure: 60–68 mm Hg (1.16–1.31 psia) at 68°F (20°C); reported values vary in this range

Flash Point: 55–56°F (12.8–13.3°C), closed cup; 59–70°F (15–21°C), open cup

Autoignition Temperature: 775°F (413°C)

Burning Rate: 1.6 mm/minute

Stability: Stable

Corrosiveness: Some authorities state that ethylene dichloride is not corrosive to metals (except aluminum-see below) when dry but corrodes iron, zinc, and aluminum in the presence of water. One adds that it corrodes iron and certain other metals "at elevated temperatures" when in contact with water. Another states it is corrosive to iron and other metals unless stabilized with alkylamines (which appears questionable given the reactivity of the product with alkylamines-see below). Several authorities agree that ethylene dichloride attacks some forms of plastics, rubber and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Incompatible and may react vigorously with strong oxidizers, strong caustics, or chemically active metals such as aluminum or magnesium powder, sodium, or potassium. Reactions with active metals (including solid aluminum), liquid ammonia, dimethylaminopropylamine (when water is present), nitrogen tetroxide, nitrogen dioxide, organic peroxides, reducing agents, nitric acid, or similar materials may e violent or explosive under appropriate conditions. Similar chemicals react with varying results with cyanides, mercaptans or other organic sulfides, azo compounds, hydrazines, nitrides mineral acids, amines, and possibly other substances. (Note: It is known that mixtures with nitric acid are easily detonated by heat, impact or friction.)

IDENTIFICATION

Shipping Names: Ethylene dichloride (USDOT and IMO)

Synonyms and Tradenames: 1,2-dichloroethane; sym-dichloroethane; ethane dichloride; ethylene chloride; glycol dichloride; Brocide; 1,2-DCE; Dutch liquid; Dutch oil; EDC

Chemical Formula: $Cl\text{-}CH\text{-}CH_2\text{-}CI$

Constituent Components (% each): Commercial grades are typically 99% or more pure

49 STCC: 49 091 66

UN/NA Designation: UN1184 (USDOT and IMO)

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant; sweet; like chloroform and ether

Common Uses: Fumigant; insecticide; used in making several other chemicals, plastics and rubber compounds; solvent and extractant for many products; degreasing, pickling, and dry cleaning agent; used m ore flotation, photography, xerography water softening, and in making adhesives, antiknock compounds, cosmetics, finish removers, pharmaceuticals soaps and scouring compounds, wetting and penetrating agents, and varnishes.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYLENE DICHLORIDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Reported values vary from approximately 5 to 100 ppm by volume in air

Unusual Hazards: Flammable, moderately volatile, chlorinated hydrocarbon. Vapors may be heavier than air at higher ambient temperatures and may travel some distance to a source of ignition and flash back.

Short Term Exposure Limit (STEL): 2 ppm for 15 minutes (OSHA, 1989)

Time Weighted Average (TWA) Limits: 10 ppm over each 8 hours of a 40–hour work week (ACGIH TLV, 1990/91); 1 ppm (OSHA PEL, 1989) under similar circumstances.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate vicinity and directly downwind of a spill. Direct contact and ingestion should also be avoided. Ethylene dichloride is regarded as a potential human carcinogen based on the results of chronic exposure studies involving laboratory animals. (Note: No single reference source appeared to provide a complete and consistent overview of the effects of exposure to ethylene dichloride via all potential routes of exposure. The following discussions were pieced together from an unusually large number of references and may not be absolutely accurate in each and every detail.)

Hazards of Skin or Eye Contact: When the skin is exposed to air, repeated contact with liquid ethylene dichloride may result in drying and cracking of the skin as well as roughness and redness due to the defatting action of the substance. When the skin exposure is prolonged, as may occur from contact with wet clothing, quite severe irritation and moderate edema and necrosis may result. Ethylene dichloride is absorbed through the skin but requires quite a large dose to cause serious acute systemic poisoning via this route; such doses are likely to require substantial and prolonged skin exposure. When splashed in the eyes, liquid ethylene dichloride may cause pain, irritation, and lachrymation. No significant or lasting injury is expected if the product is immediately washed from the eyes. There is a possibility of more serious injury, however, if removal is delayed. Although some authorities report that corneal opacity may result from direct contact with the eyes, NIOSH has found that there is no evidence of such effects. Any corneal burns resulting from splashes are expected to heal relatively quickly and without scarring. Contact lenses should not be worn when working with this chemical.

Hazards of Inhalation: Inhalation of ethylene dichloride vapors may result in irritation of the eyes, nose, throat and respiratory tract, central nervous system depression, and gastrointestinal upset with symptoms possibly including drowsiness, dizziness, headache, mental confusion, incoordination, weakness, jaundice, anemia, vomiting, diarrhea, increased urination, hypertension, cyanosis (causing bluish discoloration of the skin and mucous membranes and indicating a lack of oxygen in the blood), pulmonary edema (which may be delayed in onset), increase in myocardial (heart) irritability, unconsciousness, and even death in extreme cases from respiratory and circulatory system failure. Liver, kidney, and adrenal gland damage may result. In the death of an individual exposed to concentrated vapors for 30 minutes, coma developed 20 hours after the initial exposure. Multiple organ failures occurred and the victim died of cardiac arrhythmia on the fifth day. Autopsy revealed severely congested and edematous lungs and degenerative changes of the heart, liver, and kidneys. According to one authority, alcohol consumed before and/or after exposure may increase injury. In laboratory experiments, the maximum concentrations survived by all rats were 20,000 ppm for 12 minutes, 3000 ppm for one hour, or 300 ppm for seven hours. Fifty percent of rats died from exposure to 12,000 ppm for 32 minutes, 3000 ppm for 2.75 hours, or 1000 ppm for 7.2 hours. Note that the saturated vapor concentration of ethylene dichloride, the concentration directly over liquid pools, is at least 78,950 at a temperature of 68°F.

Hazards of Ingestion: Ethylene dichloride is moderately toxic by ingestion. Ingestion of the product is reported to result in burning of the throat and mouth and gastrointestinal distress with an overall response that is not unlike that observed from acute vapor exposures. Additional effects reported in the literature include hemorrhaging of the outer walls of the heart, lungs, interior walls of the chest cavity, and mucous membranes of the stomach and duodenum. The heart beat may be weak and there may be ulceration or bleeding from the stomach. Excessive exposures may result in death. Aspiration into the lungs during vomiting may result in delayed pulmonary edema and chemical pneumonia with possibly severe consequences.

1184

ETHYLENE DICHLORIDE
Class 3 (Flammable Liquid)

FIRE HAZARDS

Lower Flammable Limit: 6–6.2%
Upper Flammable Limit: 15.9–16%
Behavior in Fire: Flammable liquid. May generate flammable vapors upon release, particularly at warmer temperatures (see flash point). Vapors may be somewhat heavier than air and in any case may travel some distance to a source of ignition and flash back. There is some limited potential for containers to rupture violently and possibly rocket in fires. Ethylene dichloride is reported to burn with a smoky flame.
Hazardous Combustion Products: Toxic, irritating, and/or corrosive substances such as carbon dioxide, carbon monoxide, chlorine, hydrogen chloride, hydrochloric acid, phosgene, and vinyl chloride are reported by various authorities as products of combustion and/or thermal decomposition of ethylene dichloride. Other potentially hazardous substances may also be generated.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if flammable vapors are ignited in a confined area. There is some limited potential for containers to rupture violently and possibly rocket in fires. Contact with certain other chemicals or active metals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye or skin contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials for ethylene dichloride may include Viton/neoprene, Viton, and Silvershield. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high concentrations of irritating or corrosive gases generated by burning ethylene dichloride. Note that such suits may require acid-resistant materials of construction.
Respiratory Protection: For unknown concentrations, fire fighting, or any detectable concentration, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, respiratory tract, or skin. Other symptoms of central nervous system depression or gastrointestinal upset.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. At least one authority reports that administration of epinephrine may not be prudent and is contraindicated.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least *15* minutes, occasionally lifting the eyelids. Remove all clothing penetrated by ethylene dichloride immediately. Wash any affected body areas with large amounts of soap and water. Get prompt medical attention if eye contact has occurred or if skin irritation persists after washing.
***First Aid for* Ingestion:** Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately. If vomiting occurs naturally or otherwise, have victim lean forward and keep head below hips to reduce risk of aspiration of liquid ethylene dichloride into the lungs. (Note: Some authorities recommend that the victim be given large amounts of salt water, water, or milk and that vomiting be induced. There is clearly a tradeoff in risk here between the hazards of leaving ethylene dichloride in the body and the hazards associated with the possibility of aspiration of the product into the lungs if vomiting is induced. Seek expert medical advice on this topic immediately if possible. Take into account how long it may require to obtain professional medical treatment for the victim if vomiting is not induced. The recommendation above is deemed best for general purposes but may not be the best choice in all cases.)

ETHYLENE DICHLORIDE
Class 3 (Flammable Liquid)

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective. Authorities disagree on whether alcohol-resistant or regular foam should be used; it is possible that both types may be effective to some degree.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Consider wearing a fully-encapsulating vapor protective suit where contact with dense smoke containing irritating or corrosive gases generated by burning ethylene dichloride may be encountered. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility (albeit limited) that the container may rupture violently, possibly rocket, and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take into account while planning the response that ethylene dichloride is a fairly volatile flammable liquid with toxic vapors. Do not expose equipment made of aluminum, magnesium, or similar active metals to the product.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Ethylene dichloride discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethylene dichloride vapors in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain some small amounts of ethylene dichloride from contact with its vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam (regular or alcohol-resistant; authorities appear to disagree on which is best) applied to the surface of liquid pools may slow the release of ethylene dichloride vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The water content of the foam may render the ethylene dichloride more corrosive to certain metals than the dry product.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Give due consideration to the possibility of increased corrosivity to certain metals on the part of contained liquids.

ETHYLENE DICHLORIDE

Class 3 (Flammable Liquid)

TECHNIQUE

COVERAGE WITH WATER . . . Ethylene dichloride is heavier than water and only slightly soluble. Where pools of the liquid have been fully contained, there is a possibility that the application of a very light water spray to the surface of the pool for a time will build up a layer of water that will float on the ethylene dichloride and reduce its emissions of vapors.

CONSEQUENCE

Addition of water will increase the volume of contained liquid. Wet ethylene dichloride may be more corrosive to certain metals than the dry product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments. Give due consideration to the possibility of increased corrosivity to certain metals on the part of contained liquids.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethylene dichloride may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained ethylene dichloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged, develop leaks, or even possibly react with the substance. Contact with certain metals may be unusually hazardous.

MITIGATION

Use equipment compatible with the spilled product. Keep the product dry to reduce the possibility of increased corrosivity to certain metals.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, fly ash, cement powder, saw dust, straw, vermiculite, perlite, commercial sorbents or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Contact with certain metals may be unusually hazardous. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ETHYLENE DICHLORIDE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid ethylene dichloride is somewhat heavier than water and may be expected to sink to the bottom of a body of water and slowly dissolve. Note that even very small quantities of the product in water may prove highly toxic to anaerobic digestion in water or sewage treatment processing facilities.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic or flammable vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance. Use equipment compatible with the spilled product.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of sorbents may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary. Use equipment compatible with the spilled product.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1996

ETHYLENE GLYCOL*

Class 9 (Miscellaneous Hazardous Materials)

GENERAL INFORMATION

Ethylene glycol is a colorless syrupy liquid with little or no odor. Best known as a major ingredient of antifreeze and deicing solutions (which may also contain large quantities of water and other substances), it has numerous other important uses in industry and consumer products. It is ranked among the top 30 chemicals produced in the United States.It is fully soluble in water and slightly heavier, so can be expected to sink and mix freely. A melting point range of 7.7 to 9.3°F for the relatively pure product indicates that it may solidify at low ambient temperatures. A flash point range of 232 to 250°F indicates that considerable preheating is necessary to ignite the pure material or to reach temperatures at which it will evolve flammable vapors. The relatively pure liquid weighs approximately 9.3 pounds per gallon.

Ethylene glycol does not react with water or many other common materials. There is an increased risk of vigorous reaction, fire and/or explosion in the presence of strong oxidizing agents and the substance is otherwise reactive with a variety of other chemicals substances. It is not corrosive to common metals (except to aluminum at elevated temperatures) but may attack some forms of plastics, rubber, and coatings. The toxic hazard of the product at room temperatures is generally low by all routes in acute exposures. Ethylene glycol is reported to emit acrid smoke and irritating fumes when heated to decomposition.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in other Chemicals: Soluble in acetic acid, acetone and similar ketones, aldehydes, lower aliphatic alcohols, glycerol, glycol ethers, and pyridine and similar coal tar bases.

Specific Gravity (Liquid): 1.11-1.13 at 68°F (20°C)

Boiling Point: 387°F (197.6°C)at 1 atm.

Melting Point: 7.7 to 9.3°F (13.5 to 12 6°C)

Molecular Weight: 62.07

Heat of Combustion: -4033 cal/g

Vapor Pressure: 0.06 mm Hg (0.00116 psia) at 68°F (20°); about 0.20 mm Hg (0.00387 psia) at 86°F (30°C).

Flash Point: 232-250°F (111.1 -121.1°C), closed-cup; 240°F (115.6°C), open cup.

Autoignition Temperature: 748 to 775°F (397.8 to 412.8°C);

Burning Rate: 1.0 mm/minute

Stability: Stable

Corrosiveness: Not corrosive to most metals under normal conditions. May be corrosive to aluminum at temperatures above 212°F. May attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No chemical reaction.

Reactivity with other Chemicals: Increased risk of vigorous reaction, fire and/or explosion in presence of strong oxidizing agents, either immediately or when mixture is heated depending on specific oxidizer. May violently decompose in presence of perchloric acid. Mixture with acids such as oleum, 96% sulfuric acid, or chlorosulfonic acid causes temperature and pressure to rise in closed containers.

IDENTIFICATION

Shipping Name: Environmentally Hazardous Materials, Liquid, n.o.s. (Ethylene Glycol) or Other Regulated Materials, Liquid, n.o.s. (Ethylene Glycol)

Synonym and Tradenames: 1,2-Dihydroxyethane; EG; 1,2-ethanediol; ethane - 1,2-diol; ethanediol; ethylene alcohol; ethylene dihydrate; glycol; glycol alcohol; 2-hydroxyethanol; MEG; monoethylene glycol

Chemical Formula: HOCH2CH2OH

Constituent Component* (% each): Typically 99% pure even for the industrial, commercial or technical grades, but there appear to be exceptions to this rule.

UN/NA Designation: UN3082 or NA3082

IMO Designation: Class 9

Physical State As Shipped:Liquid

Physical State As Released: Liquid (solidifies at 7.7 to 9.3°F)

Color of the Shipped Material: Ethylene glycol itself is a colorless syrupy liquid but commercial products containing the substance may be any of a variety of colors.

Odor Characteristics: Odorless or with a slight odor

Common Uses: Coolant and antifreeze; extractant and solvent for various purposes; ingredient in hydraulic brake fluids, cosmetics, lacquers, alkyd resins, asphalt emulsion paints, printing inks, wood stains, adhesives, deicing fluids used at airports, ball-point pen inks, heat transfer fluids, and electrolytic condensers.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

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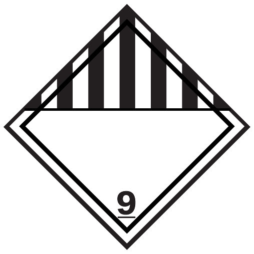
*Reportable Quantity (RQ) established. Refer to appendix I.

ETHYLENE GLYCOL
Class 9 (Miscellaneous Hazardous Materials)



POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold odor Concentration: Ethylene glycol is reported by many authorities as being odorless or having a slight odor.

Unusual Hazards: Capable of causing human injury and environmental damage under appropriate spill conditions.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Ceiling (C) Limit:: 50 ppm 1127 mg/m3, absolute ceiling limit (ACGIH, 1991-92; OSHA,1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact

HEALTH HAZARDS

Public Health Hazards: The major threat from ethylene glycol has been associated with ingestion.

Hazards of Skin or Eye Contact: Contact of the eyes with liquid ethylene glycol may cause mild or moderate discomfort, redness, and irritation but no significant corneal injury unless the product is sufficiently hot to cause a thermal burn. Long-term exposure to vapors and mists may cause temporary eye irritation according to some authorities. Contact of the skin with liquid ethylene glycol should cause no more than mild irritation though thermal burns are possible if the product is hot. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Due to its low vapor pressure, toxic concentrations of ethylene glycol in air are unlikely to occur at normal room temperatures and below. Nevertheless, vapors generated at moderate to high ambient temperatures may be irritating. In experiments, humans could not tolerate levels above 56 ppm or greater for long due to throat irritation that produced a burning sensation and coughing. Inhalation of vapors from hot liquid or of mists of ethylene glycol generated at any temperature are variously reported to cause headache, nausea, vomiting, dizziness, giddiness, rapid and involuntary eye movements, eye lacrimation, coughing, general anesthesia, respiratory system stimulation, unspecified effects on the lungs, and possible kidney and liver injury.

Hazards of Ingestion: The toxicity of ethylene glycol by ingestion is comparatively low but the product is easily and widely available and has been the cause of many cases of fatal or near-fatal poisonings. Symptoms of ingestion are reported to include nausea, vomiting, abdominal pain or discomfort, dizziness, drowsiness, malaise, blurring of vision, rapid and involuntary eye movements, irritability, lumbar pain, intoxication, stupor, reduced urination and resultant fluid retention, weakness in facial muscles, diminished hearing, difficulty in swallowing, unconsciousness, coma, and convulsions.

FIRE HAZARDS

Lower Flammable Limit: 3.2%

Upper Flammable Limit: 15.3%

Behavior in Fire: High flash point liquid. Will burn but may be difficult to ignite unless substantially preheated. Water or foam directed onto the hot burning liquid may cause frothing.

Hazardous Combustion Products: Not well-defined. When heated to decomposition, the product may is said by one authority to emit acrid smoke and irritating fumes.

EXPLOSION HAZARDS

Explosiveness: The risk of violent container rupture due to prolonged exposure to heat is very low when relatively pure ethylene glycol is involved due to the high boiling point and very low vapor pressure of the product. Be advised, however, that mixtures with some other substances including water may be more prone to container rupture.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, butyl rubber/neoprene, chlorinated polyethylene, natural rubber, neoprene, neoprene/natural rubber, nitrile rubber, nitrile rubber + polyvinyl chloride, polyethylene, polyurethane, polyvinyl alcohol, styrene-butadiene rubber (SBR), SBR neoprene, Teflon, Viton, and Viton neoprene. Clothing providing thermal protection may be required where hot liquid ethylene glycol is to be handled.

Respiratory Protection: For fire fighting or when vapors or mists are being generated from hot ethylene glycol, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For situations in which vapor pressures will be low (e.g., when the pure product is at a low to moderate ambient temperature), a gas mask with chin-style or front or back mounted organic vapor canister or a chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) may be adequate within the use limitations of these devices.

3082

ETHYLENE GLYCOL
Class 9 (Miscellaneous
Hazardous Materials)

FIRST AID

Nonspecific Symptoms: Eye, skin, or throat irritation; headache, coughing, nausea, vomiting, dizziness, giddiness, drowsiness, abdominal discomfort, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: This is the most common recommendation found in the literature but at least one authority believes that vomiting should not be induced after water is administered. Seek qualified medical advice on this issue if possible.) If vomiting is induced or occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs and then repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Water spray, alcohol foam, carbon dioxide, or dry chemical. Note that direct application of water or foam to burning ethylene glycol may cause frothing. Apply these materials cautiously and carefully at first. Water works by diluting the ethylene glycol to a noncombustible mixture.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility (although highly limited when relatively pure ethylene glycol is involved) that the container may tear or rupture and suddenly release massive amounts of product when exposed to prolonged high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance if deemed necessary to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, consider using an unmanned hose holder or monitor nozzles. If this is impossible, consider withdrawing and letting the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSE

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources as necessary. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take the temperature of the ethylene glycol into account when planning the response and take action accordingly. The toxic hazard and flammability of the product increases with temperature and this product is frequently used at high temperatures in certain types of equipment. There is a possibility that the discharge of a carbon dioxide fire extinguisher at the point of leakage of pure liquid ethylene glycol has the potential to solidify the product and stop the leak in some cases, at least temporarily. Other means attempting to solidify the leaking liquid via cooling may also work. Whether or not the "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the container and its temperature. It may become necessary to repeat the procedure several times until the leak can be patched or to ultimately abandon the effort. Use professional judgement in attempting this type of response action.

ETHYLENE GLYCOL
Class 9 (Miscellaneous Hazardous Materials)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION…Ethylene glycol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations, particularly and especially if the spill is small and/or the product is at low to moderate ambient temperatures. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ethylene glycol may be found in the air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

EVACUATION…Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Ethylene glycol discharges may expose certain downwind areas to toxic and possibly flammable concentrations in some cases if large quantities of the very hot pure liquid have been released.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY…Where deemed necessary, water fog or spray applied to ethylene glycol vapors or mists in air may absorb vapors, knock down mists, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethylene glycol from contact with its vapors or mists. Water applied to very hot pools of liquid ethylene glycol may cause frothing.

MITIGATION

Apply water at a point downwind if potential frothing of hot liquid is of concern. Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM…Where deemed necessary, alcohol foam applied to the surface of liquid pools may slow the release of ethylene glycol vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. Direct application of foam to very hot pools of liquid ethylene glycol may cause frothing.

MITIGATION

Apply foam with caution at first if it is being applied to a very hot pool of liquid ethylene glycol. Continue foam applications until spilled product is removed. Contain increased volume.

ETHYLENE GLYCOL
Class 9 (Miscellaneous Hazardous Materials)

TECHNIQUE

DILUTION…Where deemed necessary, the addition of a relatively large amount of water to liquid ethylene glycol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Direct application of water to very hot pools of liquid ethylene glycol may cause frothing.

MITIGATION

Apply water as a spray with caution at first if it is being applied to a very hot pool of liquid ethylene glycol. Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES…Liquid ethylene glycol and contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION…A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION…Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION…Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

ETHYLENE GLYCOL

Class 9 (Miscellaneous Hazardous Materials)

TECHNIQUE

MECHANICAL REMOVAL…Contaminated soil or spilled product or its residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. If the ethylene glycol is very hot, any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres; wait till the ethylene glycol has cooled. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE…Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES…Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION…Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Activated carbon is not highly effective for capturing ethylene glycol in water.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment. Activated carbon use may not prove sufficiently effective or efficient. Very large amounts of the carbon may be required.

MITIGATION

Consult qualified experts for safe carbon adsorption techniques (if this recovery technique is attempted) or other methods of treating contaminated water. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION…Water containing dissolved ethylene glycol may potentially be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body. (Note: The low vapor pressure of ethylene glycol indicates that this response technique may not be highly effective. The technique has been suggested by various authorities, however, for materials with similarly low vapor pressures.)

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment and in deciding whether the technique should be attempted under the specific spill conditions of interest. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2003

ETHYLENE GLYCOL MONOBUTYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Ethylene glycol monobutyl ether (EGBE) is a clear, flammable liquid with a mild, ether-like odor. It is also commonly known as 2-Butoxyethanol and is toxic by all routes of exposure. It has many different applications from being used in all-purpose and household solvents to making pesticides and rust removers. It has a flash point of 144°F and therefore flammable, but it can be identified as a flammable or combustible liquid when in transportation. It is reactive with strong acids, bases, caustics and some metals. On exposure to light or air, EGBE may form peroxides. It is completely soluble in water and most organic solvents. The product weighs approximately 7.5 pounds per gallon.

Ethylene glycol monobutyl ether is regarded as the most toxic glycol ether used as a solvent. Symptoms of exposure may include headaches, drowsiness, weakness, slurred speech, tremor and blurred vision. EGBE has an evaporation rate of .08 and is therefore considered a slow evaporator; nevertheless, vapors are heavier than air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of ethylene glycol monobutyl ether is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Complete

Solubility in Other Chemicals: Soluble in ethanol, acetone, mineral oil, ether and most organic solvents.

Specific Gravity (Liquid): 0.9

Vapor Density: 4.07

Boiling Point: 340°F (171°C)

Melting Point: See freezing point.

Freezing Point: -107°F (-77°C)

Molecular Weight: 118.2

Heat of Combustion: 30 kJ/g

Evaporation Rate (butyl acetate=1): .08

Vapor Pressure: 0.8 mm Hg at 68°F (20°C); 300 mm Hg at 284°F (140°C)

Flash Point: 144°F (62°C) closed cup; 158°F (70°C) open cup

Autoignition Temperature: 460°F (238°C)

Burning Rate: Unavailable

Flammable Limits: 1.1% (LFL) - 12.7% (UFL)

Stability: Stable under normal conditions, however, is sensitive to light and air.

Polymerization Potential: Will not occur

pH: 10.5 - 11.5 (reported by one source)

Reactivity with Water: None

Reactivity and Incompatibility: Strong oxidizers, strong caustics, strong bases and zinc. Incompatible with reactive metals such as aluminum and magnesium. May form peroxides on exposure to light and air. It attacks some forms of plastics, rubber and coatings.

IDENTIFICATION

Shipping Name(s): Flammable liquid, n.o.s. (Ethylene glycol monobutyl ether) (USDOT & IMO); Combustible liquid, n.o.s. (Ethylene glycol monobutyl ether) (USDOT)

Synonyms and Tradenames: 2-Butoxyethanol; 2-butoxy-1-ethanol; Butyl Cellosolve®; Butyl oxitol; Dowanol® EB; EGBE; Ektasolve EB®; Jeffersol EB

CAS Registry No.: 111-76-2

Chemical Formula: $C_4H_9OCH_2CH_2OH$ or $C_6H_{14}O_2$

Constituent Components (% each): 99% to 100% pure

UN/NA Designation: UN1993 (Flammable liquid); NA1993 (Combustible liquid)

IMO Designation: 3, Flammable liquids

RTECS Number: KJ8575000

NFPA 704 Hazard Rating: 2 (Health): 2 (Flammability): 0 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Clear colorless liquid

Odor Characteristics: Mild, ether-like odor.

Common Uses: All-purpose solvent often used in water-base paint formulations and hard surface cleaners. Solvent for nitrocellulose, natural and synthetic resins, soluble oils, lacquers, varnish and enamels. Used in textile dyeing and printing, in the treatment of leather, as a stabilizer in metal and household cleaners, in hydraulic fluids, insecticides, herbicides and rust removers.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ETHYLENE GLYCOL MONOBUTYL ETHER

Class 3 (Flammable Liquid) or
Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Approximately 4 ppm

Unusual Hazards: Product is toxic. Fumes and vapors are heavier than air. May form peroxides on exposure to light and air.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 5 ppm (24 mg/m^3) (NIOSH); 50 ppm (240 mg/m^3) (OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 700 ppm

Conditions to Avoid: Heat or sources of ignition; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Ethylene glycol monobutyl ether is regarded as the most toxic of all glycol ethers. Major hazard to public is inhalation of fumes or vapors in air but ingestion and direct physical contact is also to be strictly avoided. Chemical is usually detected by its objectionable odor prior to high levels.

Hazards of Skin or Eye Contact: May cause headache, dizziness, incoordination, nausea, vomiting, diarrhea and general weakness. Brief contact may cause slight irritation with itching and local redness. Prolonged contact may cause more severe irritation, with discomfort or pain, local redness and swelling and possible tissue destruction.

Hazards of Inhalation: High concentrations of vapor cause irritation of the respiratory tract, experienced as nasal discomfort and discharge, with chest pain and coughing. Headache, nausea, vomiting, dizziness and drowsiness may occur.

Hazards of Ingestion: May cause headache, dizziness, incoordination, nausea, vomiting, diarrhea and general weakness. Ingestion of significant quantities may result in red blood cell hemolysis.

FIRE HAZARDS

Lower Flammable Limit: 1.1%

Upper Flammable Limit: 12.7%

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas, and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable and toxic vapors upon release.

Hazardous Combustion Products: May include carbon monoxide, carbon dioxide and irritating and toxic fumes and gases.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Peroxidizable compounds can form and accumulate peroxides, which may explode when subjected to heat or shock.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

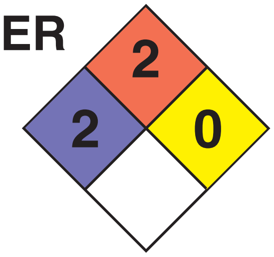
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include Viton®, butyl rubber, nitrile and neoprene (reported to have a greater than 8 hour breakthrough time). Natural rubber has a reported breakthrough time of 67 minutes and is, therefore, not recommended.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

ETHYLENE GLYCOL MONOBUTYL ETHER

1993

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Seek medical advice on whether or not to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, regular foam, water spray or carbon dioxide.

Extinguishing Techniques: Toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Do not use a solid stream of water, since the stream will scatter and spread the fire. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: Ethylene glycol monobutyl ether is a highly toxic and flammable liquid that may cause environmental contamination. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

ETHYLENE GLYCOL MONOBUTYL ETHER
Class 3 (Flammable Liquid) or Combustible Liquid

AIR RELEASE

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Ethylene glycol monobutyl ether may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ETHYLENE GLYCOL MONOBUTYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ETHYLENE GLYCOL MONOBUTYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

ETHYLENE GLYCOL MONOETHYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Ethylene glycol monoethyl ether, also commonly known as 2-ethoxyethanol, is a colorless liquid with a mildly pleasant and sweetish odor. It is used as a solvent for resins in lacquers, for dyeing leathers and textiles, and in formulating cleaners and varnish removers. It is fully soluble in water. Its flash point of 110-120°F indicates that very high ambient temperatures or some amount of heating is required before the product can be ignited easily. Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions if ignited under such conditions. There is some limited potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.8 pounds per gallon.

Ethylene glycol monoethyl ether does not react with water and is stable in normal transportation. It is incompatible with oxidizing materials, should not be used with aluminum, zinc, magnesium or galvanized metals, and is known to attack some forms of plastics, rubber, and coatings. Toxic hazard of the product is relatively low to moderate in acute exposures, but some studies with animals have indicated the possibility of adverse reproductive effects due to chronic occupational exposures. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in acetone, diethyl ether, and ethyl alcohol.
Specific Gravity (Liquid): 0.931 at 68°F (20°C)
Boiling Point: 275.2°F (135.1°C) at 1 atm.
Melting Point: -94°F (-70°C) (pour point)
Freezing Point:-94°F (-70°C) (pour point)
Molecular Weight: 90.12
Heat of Combustion: -7400 cal/g (est.)
Vapor Pressure: 4 mm Hg (0.0773 psia) at 68°F (20°C)
Flash Point: 110-120°F (43.3-48.9°C), closed cup; 118°F (47.8°C), open cup.
Autoignition Temperature: 455°F (235°C)
Burning Rate: 2.4 mm/minute
Stability: Stable
Corrosiveness: May attack some forms of plastics, rubber, and coatings. Avoid contact with aluminum, zinc, magnesium, and galvanized metals.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizing materials.

IDENTIFICATION

Shipping Names: Ethylene glycol monoethyl ether (USDOT and IMO)
Synonyms and Tradenames: 2-Ethoxyethanol; ethylene glycol ethyl ether; glycol monoethyl ether; Poly-Solv EE; Dowanol EE; Cellosolve; ethyl cellosolve; Ektasolve EE; emkanol; hydroxyether; Oxitol; Plastiazan 60.
Chemical Formula: $HOCH_2CH_2OCH_2CH_3$
Constituent Components(% each): 95% pure
UN/NA Designation: UN1171
IMO Designation: 3.3, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sweetish, mild, pleasant, ethereal
Common Uses: Solvent for resins in lacquers; used for dyeing leathers and textiles and formulating cleaners and varnish removers.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYLENE GLYCOL MONOETHYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 25 ppm

Unusual Hazards: None

Short Term Exposure Limits(STEL): (Skin) 100 ppm for 15 minutes. (ACGIH) (Note: Deletion of STEL proposed.)

Time Weighted Average(TLV-TWA): (Skin) 50 ppm over each 8 hours of a 40 hour work week.(ACGIH) (Note: 5 ppm proposed.)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the relatively high vapor concentrations that may be present in the immediate spill area and immediately downwind. Ingestion and direct contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact of liquid ethylene glycol monoethyl ether with the skin only causes a mild irritation, but toxic amounts may possibly be absorbed through the skin. Contact with the eyes may result in immediate discomfort, some conjunctival irritation, and temporary irritation of the cornea.

Hazards of Inhalation: Vapors of ethylene glycol monoethyl ether are somewhat irritating to the eyes and nose. High concentrations in air may result in headache, nausea, injury to the lungs, kidneys and blood, and pulmonary edema with possibly severe consequences. Exposure to 1820 ppm in air for seven hours was fatal to 50% of mice in laboratory experiments.

Hazards of Ingestion: Data unavailable. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 1.7-1.8%

Upper Flammable Limit: 14-15.6%

Behavior in Fire: Combustible liquid. Will burn but may be somewhat difficult to ignite. May generate some amounts of flammable vapors upon release if heated. There is some limited potential that containers may rupture violently in fire.

Hazardous combustion products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of warmed liquid are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, or skin; headache or nausea.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

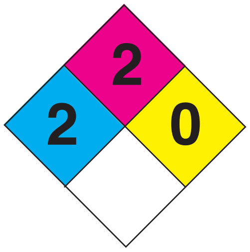
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

1171

ETHYLENE GLYCOL MONOETHYL ETHER

Class 3 (Flammable Liquid) or Combustible Liquid



FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam. Water spray may be used to dilute spills to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that the spilled product is a combustible liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... The spilled product may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of the chemical in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray may absorb chemical vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of chemical from contact with vapors in the atmosphere.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to the spilled product may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ETHYLENE GLYCOL MONOETHYL ETHER
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ALCOHOL FOAM ... There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Ethylene glycol monoethyl ether may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethylene glycol monoethyl ether may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the over all volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ETHYLENE GLYCOL MONOETHYL ETHER
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Carbon is of relatively low effectiveness.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

ETHYLENE GLYCOL MONOETHYL ETHER ACETATE

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Ethylene glycol monoethylether acetate is a colorless liquid with a pleasant, sweet, musty odor. It is used as a solvent or ingredient for lacquers, stains, adhesives, paints, coatings, and other products. Moderately stable in water and slightly lighter, it can be expected to form a floating surface or near-surface slick that rapidly dissolves. Its flash point of 124-130°F indicates that the product must be moderately heated or exposed to high ambient temperatures before it can be ignited easily. Accumulations of vapors in confined spaces such as sewers or buildings may result in explosions if ignited under such conditions. Containers have some potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.1 pounds per gallon.

Ethylene glycol monoethylether acetate does not react with water or many other common materials but is incompatible with strong oxidizers and strong alkalies. It is stable in normal transportation and should be of low to moderate toxicity under spill conditions likely to be encountered. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 23.9% at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, acetone, aromatic hydrocarbons, and ether.
Specific Gravity (Liquid): 0.975 at 68°F (20°C)
Boiling Point: 313-313.5°F (156.1-156.4°C) at 1 atm.
Melting Point: -79.1°F (-61.7°C)
Freezing Point: -79.1°F (-61.7°C)
Molecular Weight: 132.16
Heat of Combustion: -6000 cal/g (est.)
Vapor Pressure: 1.2-2.0 mm Hg (0.023-0.039 psia) at 68°F (20°C)
Flash Point: 124-130°F (52-54°C), closed cup; 117-135°F (47.2-57.2°C), open cup.
Autoignition Temperature: 715°F (379°C)
Burning Rate: Unavailable
Stability: Stable
Corrosiveness: Unavailable; shipped in steel containers.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizers and strong alkalies including nitrates and strong acids.

IDENTIFICATION

Shipping Names: Ethylene glycol monoethylether acetate (USDOT and IMO); 2-ethoxyethyl acetate (IMO).
Synonyms and Tradenames: Acetic acid, 2-ethoxyethyl ester; beta-or 2-ethoxyethyl acetate; cellosolve acetate; 2-ethoxyethanol acetate; ethoxy acetate; ethoxyethyl acetate; oxytol acetate; ethyl glycol acetate; glycol monoethyl ether acetate; Ektasolve EE acetate; glycol ether EE acetate; Poly-solv EE acetate.
Chemical Formula: $CH_3CO_2CH_2CH_2OC_2H_5$
Constituent Components(% each): 99% or more pure with traces of water and ethylene glycol monoethyl ether.
UN/NA Designation: UN1172
IMO Designation: 3.3, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pleasant, sweet, pungent, musty; like ester or ether.
Common Uses: Solvent or ingredient for nitrocellulose, oils, resins, lacquers, paints, coatings, stains, adhesives, varnish removers, and other products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYLENE GLYCOL MONOETHYL ETHER ACETATE

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Recognized at 0.25 ppm or less in air.

Unusual Hazards: Combustible hydrocarbon. There are some indications that it may cause adverse reproductive system effects in the occupational environment.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): (Skin) 50 ppm over each 8 hours of a 40 hour work week.(ACGIH) A 5 ppm TLV is being proposed.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of concentrated vapors. There are indications that the product may injure male reproductive systems and pregnant females, however, so it is wise to minimize any unnecessary exposures.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with the liquid product may cause moderate irritations, defatting, and dermatitis. The product is absorbed through the skin slowly. Contact with the eyes may cause severe irritation, redness, tearing and blurred vision, but only slight and reversible injury.

Hazards of Inhalation: High vapor concentrations in air may cause irritation of the eyes, nose, and respiratory tract. Very high levels (near saturation) in air may cause depression of the central nervous system with symptoms including dizziness, weakness, fatigue, nausea, headache, possible unconsciousness and even death. Blood changes and lung or kidney injury are also possible.

Hazards of Ingestion: Single oral doses are not considered very toxic but may cause gastrointestinal irritation, nausea, vomiting, and diarrhea. Significant ingestion may result in death.

FIRE HAZARDS

Lower Flammable Limit: 1.7%

Upper Flammable Limit: 6.7%

Behavior in Fire: Combustible liquid. Will burn but difficult to ignite unless heated. There is some potential that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: 1.8%; 1.24% at 199°F (93°C)

Upper Explosive Limit: 12.7% at 275°F (135°C)

Explosiveness: Explosion may result if vapors of warm liquid are ignited in a confined area. There is some potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

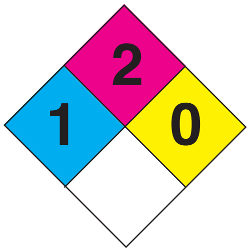
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (2500 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use of limitations these devices.

1172

ETHYLENE GLYCOL MONOETHYL ETHER ACETATE

Class 3 (Flammable Liquid) or Combustible Liquid



FIRST AID

Nonspecific Symptoms: Eye, nose, respiratory tract, or gastrointestinal irritation; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if there is skin irritation.

First Aid for Ingestion: If victim is conscious, administer two glasses of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting not be induced if immediate medical attention is available.)

FIRE RESPONSE

Extinguishing Materials: Water spray, alcohol foam, carbon dioxide, dry chemical.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spill product. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... This product may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of the chemical in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to chemical vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of chemical from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

ETHYLENE GLYCOL
MONOETHYL ETHER ACETATE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of chemical vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if the response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... The product may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

ETHYLENE GLYCOL MONOETHYL ETHER ACETATE

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other substances compatible with the chemical.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Ethyleneimine is a highly toxic, colorless and flammable liquid that is fully soluble in water and has a strong pungent fishy odor resembling ammonia. The toxicity of the product is extremely high by all routes of exposure and is also a potential carcinogen. It has a wide flammable range. It is used for oil refining, textile treatment, ion exchange, and making protective coatings, pharmaceuticals, adhesives, surfactants, polymer stabilizers, and other products and chemicals. Its low flash point indicates it may be easily ignited under most ambient temperature conditions. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below). The product weighs approximately 6.9 pounds per gallon.

Ethyleneimine reacts with water in a non-hazardous fashion. Excessive heat or the presence of silver, aluminum, other catalytically active metals, acids, acid-forming materials, chloride ions, oxidizers (possibly), or carbon dioxide (possibly) may result in self-polymerization with violent rupture of its container. The liquid usually contains inhibitors to prevent polymerization. Reactions with silver, chlorine, or sodium hypochlorite may form explosive compounds, and ethyleneimine is also reactive with a variety of other chemicals. It is a corrosive substance but is compatible with a number of materials of construction described below. Products of combustion include toxic oxides of nitrogen, carbon monoxide, and other toxic constituents.

If ethyleneimine is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. (Note: Large discharges may require evacuation over considerable downwind distances.) If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in alcohol, ether, acetone, benzene, and most other organic solvents.

Specific Gravity (Liquid): 0.832 at 68ºF (20ºC)

Vapor Density: 1.5

Boiling Point: 131 - 134.6ºF (55 - 57ºC) at 1 atm.

Melting Point: -108.4ºF (-78ºC) or -96.7 to -95.8ºF (-71.5 to -71ºC); reported values vary.

Freezing Point: See melting point

Molecular Weight: 43.07

Heat of Combustion: -8850 cal/g

Evaporation Rate: Unavailable

Vapor Pressure: 160 mmHg (3.093 psia) at 68ºF (20ºC)

Flash Point: 12ºF (-11.1ºC), closed cup; -4 to 1ºF (-20 to -17.2ºC); open cup

Autoignition Temperature: 608 - 612ºF (320 - 322ºC)

Burning Rate: Unavailable

Flammable Limits: 3.3% (LEL) - 46-54.8% (UEL)

Stability: Stable in normal transportation but may polymerize violently upon excessive heating or if contaminated by certain materials.

Polymerization Potential: May polymerize violently in contact with acids, acid-forming materials, carbon dioxide, possibly oxidizers, silver, aluminum, other catalytically active metals, or chloride ions.

Corrosiveness: Corrosive; may be stored and handled in tin, lead, low carbon steel, polyethylene, kel-f, and teflon. Avoid any and all contact with silver or aluminum.

Reactivity with Water: Mild non-hazardous reaction with some generation of heat.

Reactivity and Incompatibility: Forms explosive compounds with silver (including silver solder), chlorine, or sodium hypochlorite. Also reactive with acrolein, allyl chloride, carbon disulfide, epichlorohydrin, glyoxal, vinyl acetate, oxidizing agents, beta-propiolactone, and other materials.

IDENTIFICATION

Shipping Name(s): Ethyleneimine, inhibited (USDOT & IMO)

Synonyms and Tradenames: Ethylenimine; Aziridine; Azacyclopropane; Dimethyleneimine; Dimethylenimine; Dihydroazirene; Dihydroazirine; Aminoethylene; Azirane; Aziran; Vinylamine; Ethirydine; Dihydro-1h-azirine

CAS Registry No.: 151-56-4

Chemical Formula: C_2H_5N (ring structure)

Constituent Components (% each): Approximately 99% pure; contains pellets or lumps of sodium hydroxide to inhibit polymerization.

UN/NA Designation: UN1185

IMO Designation: 6.1, Toxic substances

RTECS Number: KX5075000

NFPA 704 Hazard Rating: 4(Health): 3(Flammability): 3(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Like ammonia or amine; intense; fishy; pungent.

Reportable Quantity: See appendix I.

Common Uses: Fuel oil and lubricant refining; ion exchange; making coatings, pharmaceuticals, adhesives, surfactants, polymer stabilizers, and other chemicals. Several applications for treating textiles.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Approximately 2 ppm.

Unusual Hazards: Potential carcinogen. Wide range of flammability. Highly toxic, flammable, reactive, and relatively volatile liquid. May polymerize violently if exposed to excessive heat or contaminated by various materials. Vapors are not inhibited and may form polymers in vents or flame arresters resulting in stoppage.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.5 ppm (ACGIH)

Ceiling (C) Limit: Unavailable

IDLH: 100 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Ethyleneimine is an extremely toxic substance that attacks the body in many ways, is a suspected human carcinogen, and may also have mutagenic and teratogenic effects. All exposures to this substance should be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid ethyleneimine may result in severe blisters and slow healing burns. The product can be absorbed through the skin extremely rapidly in toxic amounts causing various effects of ingestion or inhalation and may on occasion cause sensitization of the skin. Burns may be painless (at least initially). Some effects may be delayed. Contact with the eyes may cause burns, corneal necrosis, conjunctival scarring, permanent eye damage, and even death.

Hazards of Inhalation: Vapors of ethyleneimine are extremely irritating to the eyes (effects may get worse over several hours after exposure), mucous membranes, nose, throat, and upper respiratory tract. Inhalation may result in sore throat, swelling of the face, persistent coughing, nausea, vomiting, headache, dizziness, difficult breathing, laryngeal edema, delayed lung injury and congestion, bronchitis, hemorrhage, effects on blood constituents, kidney damage, pulmonary edema, bronchial pneumonia, convulsions, and death. Several effects may be delayed in onset. A concentration of 5 ppm in air causes severe discomfort and irritation in 30 minutes. A 10-minute exposure to 2236 ppm was lethal to 50% of mice in laboratory experiments. Levels ranging from 50 to 1500 ppm were lethal to 50% of a variety of animals exposed for 30 minutes.

Hazards of Ingestion: Ethyleneimine is highly toxic if ingested. Effects may include burns of the mouth and throat, scarring of the esophagus, kidney and liver injury, damage to the rods and cones of the retina leading to blindness, other symptoms associated with inhalation, and death.

FIRE HAZARDS

Lower Flammable Limit: 3.3% (or possibly 3.6%); reported values vary.

Upper Flammable Limit: 46% (or possibly 54.8%); reported values vary.

Behavior in Fire: Flammable liquid. May generate large quantities of flammable and highly toxic vapors upon release. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in explosive polymerization.

Hazardous Combustion Products: Not well defined; may include toxic oxides of nitrogen, carbon monoxide, and other toxic substances.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat may cause spontaneous violent polymerization resulting in explosion. Explosive polymerization may also occur in presence of acids, acid-forming materials, possibly carbon dioxide, possibly oxidizers, silver, aluminum, other catalytically active metals, or chloride ions. Contact with other chemicals such as silver, chlorine, or sodium hypochlorite may result in formation of explosive mixtures.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

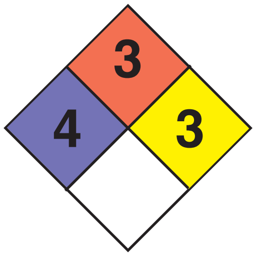
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas-tight safety goggles, and other impervious and resistant clothing. Tychem® 10,000 is reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece.

1185

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, headache, dizziness, nausea, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Authorities disagree on whether or not vomiting should be induced, probably due to the possibility that aspiration into the lungs during vomiting may lead to pulmonary edema or other injury. Seek immediate medical advice on this issue where possible.)

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, alcohol resistant foam. There are indications that carbon dioxide should not be used but this is uncertain. Water may be ineffective but may be used to dilute spill to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear self-contained breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Take into consideration the highly toxic nature of ethyleneimine while planning the response. Downwind evacuation should be considered. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Take the volatile, flammable, reactive, and highly toxic nature of ethyleneimine into account when planning the response.

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyleneimine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of ethyleneimine from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid ethyleneimine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL RESISTANT FOAM . . . There is a possibility that alcohol resistant foam applied to the surface of liquid pools may slow the release of ethyleneimine vapors into the atmosphere. The fact that alcohol resistant foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Ethyleneimine may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined ethyleneimine may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, soda mix (90-10), commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

ETHYLENEIMINE, INHIBITED

Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. Cationic exchangers may be used for neutral or acidic solutions.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 1992

ETHYLENE OXIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Ethylene oxide is a gas or extremely volatile colorless liquid with the relatively low boiling point of 51.1°F. It has a sweet ether-like odor and is used as a fumigant, fungicide, sterilization agent, and intermediate for making drugs, pesticides, antifreeze, plastics, and other chemicals. It is fully soluble in water. Its flash point of well below 0°F indicates that this product may easily be ignited under all ambient temperature conditions. Its low boiling point suggests that the liquid will boil or otherwise rapidly evaporate when spilled, thus evolving large amounts of vapor. The vapors are irritating to the eyes, skin and respiratory system. Prolonged contact with the skin may result in delayed burns. These vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, or depressions. Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions if ignited and there is also some known potential for explosions involving unconfined vapor clouds. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The liquid weighs approximately 7.2 pounds per gallon.

Ethylene Oxide reacts slowly with water in a nonhazardous fashion. Excessive heat or the presence of highly active catalytic surfaces, acidic or alkaline materials, or metal oxides or chlorides may result in self-polymerization with violent rupture of its container, however, and the product is otherwise reactive with a variety of chemicals. It is not considered to be highly corrosive but copper, silver, mercury, or magnesium and their alloys should not be used. The product is of moderate to high toxicity and is suspected of being a carcinogen. Products of combustion are hazardous and irritating.

If material is leaking (not on fire), evacuate for a radius of 2500 feet. If a fire is prolonged or uncontrollable, or if a container is exposed to direct flame, evacuate for a radius of 5000 feet for protection from flying debris if the container should rupture violently.

Note: the material has to be diluted on the order of 24 to 1 with water before the liquid loses its flammability. If contaminated, it may polymerize violently with evolution of heat and rupture of its container. The vapors may burn inside a container.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.881 at 50°F (10°C)
Boiling Point: 51.1°F (10.6°C) at 1 atm.
Melting Point: –167.8°F (–111°C)
Freezing Point: 170.7°F (–112.6°C)
Molecular Weight: 44.05
Heat of Combustion: –6380 cal/g
Vapor Pressure: 1.43 atm (21.1 psia) at 68°F (20°C)
Flash Point: Less than 0°F (–17.8°C)
Autoignition Temperature: 804°F (428.9°C) in air; 1060°F (571.1°C) without air.
Burning Rate: 3.5 mm/minute
Stability: Stable, but may polymerize under conditions described above.
Corrosiveness: Noncorrosive, but do not use copper, silver, mercury, or magnesium or their alloys. Do not use neoprene, natural rubber, or asbestos gasket materials to seal containers.
Reactivity with Water: *Slow,* nonhazardous
Reactivity with Other Chemicals: Reacts with acids; bases; alcohols; magnesium perchlorate; mercaptans; potassium; highly active catalytic surfaces such as anhydrous iron, tin and aluminum chlorides, pure iron and aluminum oxides and alkali metal hydroxides; and other metal oxides and chlorides.

IDENTIFICATION

Shipping Names: Ethylene oxide (USDOT and IMO)
Synonyms and Tradenames: 1,2-Epoxyethane; oxirane; dihydrooxirene; dimethylene oxide; epoxyethane; ethneoxide; ethyloxide; oxyacyclopropane; oxane; oxidoethane; oxyfume 12; anprolene; T-gas; EO; EtO.
Chemical Formula: $-CH_2CH_2-O$
Constituent Components (% each): 99.9 –100% pure with trace of nitrogen
49 STCC: 49 201 08
UN/NA Designation: UN1040
IMO Designation: 2.3, Poison Gas
Physical State as Shipped: Gas or Liquid.
Physical State as Released: Liquid or gas (boils at 51.°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, pungent, ether-like
Common Uses: Fumigant for foods and textiles; agricultural fungicide; sterilization of surgical equipment; mfg. of drugs, pesticides, plastics, antifreeze, and other chemicals

ETHYLENE OXIDE
Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** 0.8–700 ppm; reported values vary widely.

Unusual Hazards: Extremely volatile flammable liquid with heavier than air vapors that may travel considerable distance to a source of ignition. May polymerize violently in container if exposed to heat, acidic or alkaline materials, metal oxides or chlorides, or highly active catalytic surfaces. Vapors may persist in pits, hollows, or depressions. Liquid may burn in closed containers if ignited. Some mixtures of ethylene oxide and water will burn.

Short Term Exposure Limits (STEL): unavailable

Time Weighted Average (TLV-TWA): *10* ppm over each *8* hours of a 40 hour work week. (ACGIH) (Note: 1 ppm has been proposed.)

Conditions to Avoid: Heat, fire and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air, but direct contact and ingestion should also be strictly avoided. Ethylene oxide is suspected to be a human carcinogen in occupational exposures.

Hazards of* Skin *and Eye Contact: Contact of liquid ethylene oxide or contaminated leather or rubber with the skin may cause irritation, sensitization and characteristic burns (after a latent period of 1–5 hours) as well as the possibility of frostbite. The undiluted liquid or solutions may cause severe eye irritation or damage.

Hazards of Inhalation: Vapors of ethylene oxide irritate the eyes and respiratory tract and may cause a peculiar taste. High concentrations in air cause central nervous system depression with effects including headache, nausea, vomiting, difficult breathing, cyanosis, drowsiness, weakness, incoordination, unconsciousness, and possibly death. Many of these effects and resulting pulmonary edema may be delayed up to days. Exposure to 835 ppm for 4 hours was deadly to 50% of mice in laboratory experiments.

Hazards of Ingestion: Moderately toxic (see effects of inhalation); may cause sensitization.

FIRE HAZARDS

Lower Flammable Limit: 3%

Upper Flammable Limit: 100%

Behavior in Fire: Flammable liquid. Will generate large quantities of flammable vapors upon release. Vapors are heavier than air, may accumulate and persist in low areas, and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in explosive polymerization. Material can burn in sealed containers if ignited.

Hazardous Combustion Products: Unknown, but considered hazardous and irritating.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. There is some known potential for explosions involving unconfined vapor clouds. Excessive heat or chemical contamination may cause spontaneous polymerization resulting in violent container rupture (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact and any possibility of skin contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, nitrile rubber, and chlorinated polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1040

ETHYLENE OXIDE
Division 2.3 (Poison Gas)

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or respiratory tract; symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: Do not use hot water if frostbite has occurred.)

***First Aid for* Ingestion:** If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of warm water to pools of liquid ethylene oxide may increase vapor evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile, flammable, and heavier than air nature of ethylene oxide into account while planning the response. Avoid use of materials listed in the Corrosiveness section.

AIR SPILL

TECHNIQUE

EVACUATION. . .Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethylene oxide spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYLENE OXIDE
Division 2.3 (Poison Gas)

TECHNIQUE

WATER FOG OR SPRAY. . .Water fog or spray applied to ethylene oxide vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. If water is warm and pools of pure liquid ethylene oxide are on the ground, apply water at a point downwind and do not allow it to contact such pools as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of ethylene oxide from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM... Alcohol foam applied to the surface of liquid pools may slow the release of ethylene oxide vapors into the atmosphere. (Note: AFFF is not very effective; fluoroprotein is fairly effective. Alcohol foams are best.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION... The rapid addition of flooding quantities of water to liquid ethylene oxide may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time, particularly if the water is warmer than the ethylene oxide.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethylene oxide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained ethylene oxide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ETHYLENE OXIDE
Division 2.3 (Poison Gas)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques when air emissions may pose a downwind hazard.

October 1993

2-ETHYLHEXYL ACRYLATE
Combustible Liquid

GENERAL INFORMATION

2-Ethylhexyl acrylate, is a colorless, and only slightly volatile liquid with an odor variably described as pleasant, sweet, inoffensive, strong, acrid, musty, sharp, and objectionable. The liquid is very slightly soluble in water and lighter, so may be expected to form a floating surface slick that dissolves into water and evaporates into air at very slow rates. This substance must be preheated before it can be easily ignited. Vapors evolved from liquid 2-ethylhexyl acrylate heated above its flash point may travel some distance to a source of ignition and flash back. Similarly, accumulations of such vapors may explode if ignited in confined spaces such as buildings or sewers. The product weighs approximately 7.4 pounds per gallon.

2-Ethylhexyl acrylate does not react with water or many other common materials and is stable in normal transportation, provided it is inhibited to prevent self-polymerization which may result in violent or explosive rupture of closed containers. Such polymerization can occur if the product is exposed to excessive heat, excessive sunlight or x-rays, or various contaminants; has an insufficient concentration of inhibitor present; or is stored in the absence of air. It may attack many forms of plastics, rubber, and coatings. Toxicity of the material is low to moderate by direct contact and ingestion; its toxicity by inhalation has not been studied sufficiently to permit full characterization but generally appears low. Products of combustion are reported to include acrid smoke and irritating fumes.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if 2-ethylhexyl acrylate is leaking or otherwise venting from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble.

Solubility in Other Chemicals: Not available.

Specific Gravity (Liquid): 0.885 - 0.887 at 68°F (20°C).

Boiling Point: 416.3 - 424.4°F (213.5 - 218°C) at 1 atm.

Melting Point: - 130°F (- 90°C).

Freezing Point: See melting point.

Molecular Weight: 184.3.

Heat of Combustion: - 8,600 cal/g.

Vapor Pressure: 0.10 - 0.14 mm Hg (0.0019 - 0.0027 psia) at 68°F (20°C); 1.0 mm Hg (0.0193 psia) at 122°F (50°C).

Flash Point: 175 -189°F (79.4 - 87.2°C); closed-cup; 180 - 200°F (82.2 - 93.3°C); open-cup.

Autoignition Temperature: 485 or 496°F (252 or 258°C).

Burning Rate: 4.6 mm/minute.

Stability: Stable in normal transportation when properly inhibited. Excessive heat, exposure to sunlight (ultraviolet light) or x-rays, or contamination by certain chemical substances may result in an exothermic and potentially violent self-polymerization reaction that may result in violent or explosive rupture of a closed container.

Corrosiveness: Suitable materials are reported to include aluminum, steel, and stainless steel by one maker of the product. May attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: The oxygen found in air helps to inhibit polymerization but 2-ethylhexyl acrylate is not compatible with pure oxygen. Contaminants that initiate violent polymerization reactions include free radical initiators, organic and other peroxides, oxidizers and other polymerization initiators. The substance is also said to be incompatible with reducing agents, strong acids, bases (alkalis), or halogens.

IDENTIFICATION

Shipping Names: Combustible liquid, n.o.s. (2-ethy1hexyl acrylate).

Synonyms and Tradenames: Acrylic acid, 2-ethylhexyl ester; EHA; 2-ethylhexyl acrylate; 2-ethylhexyl-2-propenoate; 1-hexanol, 2-ethyl-, acrylate; octyl acrylate; and 2-propenoic acid, 2-thylhexyl ester.

Chemical Formula: $CH_2{=}CHCOOCH_2CH(CH_2H_5)C_4H_9$.

Constituent Components (% each): Apparently 99% or more pure with remainder consisting of other ester adducts and possibly other substances.

UN/NA Designation: NA1993.

IMO Designation: Not regulated.

Physical State As Shipped: Liquid.

Physical State As Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Variably described as pleasant; sweet; inoffensive; strong, acrid, and musty; sharp; and objectionable.

Common Uses: Used for paper treatment and to make plastics, protective coatings, and water-based paints.

2-ETHYLHEXYL ACRYLATE
Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.05 to 0.2 ppm

Unusual Hazards: Various conditions may initiate an exothermic self-polymerization reaction that may result in violent or explosive rupture of a closed container, potentially releasing large amounts of hot unpolymerized vapors and mists into the atmosphere if a source of ignition is not encountered. Vapors may possibly be uninhibited and form polymers in vents or flame arresters, resulting in stoppage of flow. Use of water or foam on fires must be undertaken carefully to avoid frothing, spattering, and potential tank boilover hazards.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established by a recognized authority. Two major manufacturers recommend a TWA of 5 ppm over each 8 hours of a 40 hour work week in their respective MSDS documents.

Ceiling (C) Limit: Not established

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; oxygen-free atmospheres in containers; long-term storage; and other conditions that may result in self-polymerization.

HEALTH HAZARDS

Public Health Hazards: Unless this material undergoes an exothermic reaction (polymerization) there appears to be little risk to anyone not in the immediate spill area. The odor of the chemical may be detected far further downwind than it is harmful in short-term exposures. There will be a risk downwind if an uncontrolled exothermic reaction takes place which result in container rupture & the release of massive amounts of hot vapors & mists.

Hazards of Skin or Eye Contact: Although information in the literature is inconsistent, contact of liquid 2-ethylhexyl acrylate with the eyes appears to have the potential to cause severe irritation and possible injury which is likely to be temporary. Vapors of the liquid are likely to be irritating. Brief contact of the skin with liquid 2-ethylhexyl acrylate may cause minimal irritation, if any, but prolonged contact may result in smarting, irritation (possibly severe), inflammation, and/or swelling. The skin of some susceptible people may become sensitized, particularly upon repeated exposure, such that they become allergic. Liquid 2-ethylhexyl acrylate can be absorbed through intact skin but at such a slow rate that a single exposure, unless massive and prolonged, is not likely to result in significant intoxication. Contact lenses should not be worn when working with this material.

Hazards of Inhalation: Vapors and mists of 2-ethylhexyl acrylate appear to be irritating to the nose, throat, upper respiratory tract, and lungs; prolonged and/or repeated overexposure may result in damage to these organs. Symptoms of excessive exposure are reported to include drowsiness, headache, convulsions, incoordination, coughing, difficult breathing, increased rate of respiration, and pulmonary edema which may be delayed in onset and have severe consequences. The saturated vapor concentration directly over a pool of liquid 2-ethylhexyl acrylate is about 131 - 184 ppm at 68°F (20°C) and 1315 ppm at 122°F (50°C). Much greater concentrations and downwind hazards may be experienced, however, if a container in which an exothermic self-polymerization reaction is taking place ruptures or otherwise vents large amounts of hot vapors and mists into the atmosphere and these contaminants do not encounter a source of ignition.

Hazards of Ingestion: 2-Ethylhexyl acrylate is considered to be of low toxicity by ingestion. Excessive intake of the liquid may cause many of the effects of inhalation overexposure according to some authorities, as well as and including severe irritation of the mouth, throat and stomach, stimulation of the central nervous system, dizziness, nausea, vomiting, diarrhea, difficulty in breathing, nervousness, convulsions, collapse, paralysis, and/or death in extreme cases. The lowest single oral dose required to kill 50% of rats is 5.6 grams of liquid 2-ethylhexyl acrylate per kilogram of an animal's body weight.

FIRE HAZARDS

Lower Flammable Limit: 0.7 - 0.8%.

Upper Flammable Limit: 6.4 to 8.2%.

Behavior in Fire: Combustible liquid. Requires preheating to be easily ignited. May generate flammable vapors upon release when at a temperature at or above its flash point. Such vapors may travel to a source of ignition and flash back. Heat can cause a violent self-polymerization reaction with rapid release of energy, causing sealed containers to rupture violently or explosively and to possibly rocket.

Hazardous Combustion Products: Not well-defined; reported to produce acrid smoke and irritating fumes including but not limited to carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

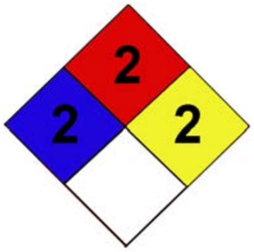
Explosiveness: Explosion may result if vapors from liquid 2-ethylhexyl acrylate at or above its flash point are ignited in a confined area. Containers may rupture violently or explosively and possibly rocket in a fire. There is a possibility that contact with certain other chemicals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, vapor-tight safety goggles, and other impervious and resistant clothing for normal operations. Several authorities recommend use of fully encapsulating suits with self-contained breathing

1993

2-ETHYLHEXYL ACRYLATE
Combustible Liquid



PROTECTIVE CLOTHING AND EQUIPMENT *(CONTINUED)*

apparatus (SCBA) for protection during fire fighting or in emergency spill situations. Compatible materials for 2-ethylhexyl acrylate itself may possibly include butyl rubber, polyvinyl chloride (PVC), neoprene, and Teflon according to various information sources. Many factors affect the suitability of a material for any given application.

Respiratory Protection: For unknown concentrations, fire fighting, or general use, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). A gas mask with chin-style or front or back mounted organic vapor canister or a chemical cartridge respirator with a full facepiece and organic vapor cartridges) may be adequate for "normal" operations at times within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues; drowsiness, dizziness, headache, coughing, nausea, vomiting, diarrhea, difficult breathing, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing. At least one authority recommends that contaminated leather clothing be discarded.

First Aid for Ingestion: Advice in the literature is inconsistent. If victim is conscious and not convulsing, administer large quantities of water. Get medical attention immediately or advice of physician as to whether vomiting should be induced. (Note: The oral toxicity of 2-ethylhexyl acrylate has to weighed against the risk of pulmonary edema and other effects if aspiration into the lungs takes place during induction of vomiting. Since oral toxicity is low, the amount of liquid ingested will be an important deciding factor on how promptly action to empty the stomach should be taken) If vomiting is induced or occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective. Regular or alcohol foam may be effective to some degree. Application of water or foam as a direct stream onto burning 2-ethylhexyl acrylate may possibly result in potentially violent frothing or spattering; entry into burning tanks of the product may possibly result in violent frothing or boilover that may hazardous to nearby personnel. Apply water or foam as a spray with caution and from a distance at first.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to heat. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after the fire is out but do not direct water streams into burning containers. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines as necessary prior to use. Be advised that: 1) Adequate inhibitor is necessary to prevent an exothermic reaction; 2) inhibitors in 2-ethylhexyl acrylate monomer are more effective in the presence of oxygen in air; 3) it is necessary to maintain a space filled with air over liquid surfaces in all containers.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Since sufficient information indicating otherwise is not available, it is prudent to assume that 2-ethylhexyl

2-ETHYLHEXYL ACRYLATE
Combustible Liquid

AIR SPILL *(CONTINUED)*

acrylate discharges may expose downwind areas to toxic concentrations in certain cases, particularly if relatively large amounts have spilled in warm weather. Of greatest concern is a situation in which an uncontrolled exothermic self-polymerization reaction takes place in a container not exposed to fire or another source of ignition and the container either ruptures suddenly or otherwise spews out massive amounts of hot unpolymerized vapors and mists into the atmosphere, in which case evacuation distances may possibly have to be considerable.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION . . . Liquid 2-ethylhexyl acrylate may not evolve hazardous levels of airborne contaminants in some outdoor spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed, particularly if relatively small amounts have spilled and there is no danger of a polymerization reaction taking place in a large container of the substance.

CONSEQUENCE

Hazardous levels of 2-ethylhexyl acrylate may possibly be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to 2-ethylhexyl acrylate vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of 2-ethylhexyl acrylate from contact with its airborne vapors.

MITIGATION

Where deemed necessary, contain contaminated water and remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam (either regular or alcohol type) applied to the surface of liquid pools may slow the release of 2-ethylhexyl acrylate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid 2-ethylhexyl acrylate may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

2-ETHYLHEXYL ACRYLATE
Combustible Liquid

LAND SPILL *(CONTINUED)*

TECHNIQUE

PUMPINGNACUUM SUCTION. . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Improperly designed or contaminated equipment could contribute to the risk of a dangerous self-polymerization reaction taking place within the recovery equipment.

MITIGATION

Use equipment compatible with the spilled product. Ensure it is suitable for recovery and storage of 2-ethylhexyl acrylate.

TECHNIQUE .

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid 2-ethylhexyl acrylate will float on the surface of the water while very slowly evaporating into the atmosphere and dissolving into the water. Some vapors may evolve from the water surface and travel in the downwind direction as the contaminated water moves downstream. The substance is toxic to aquatic life and not very biodegradable.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of bypass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

2-ETHYLHEXYL ACRYLATE
Combustible Liquid

WATER SPILL *(CONTINUED)*

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, or small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating liquid 2-ethylhexyl acrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose a hazard to future users.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with 2-ethylhexyl acrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources. Note that noncombustible sorbents are preferred when available in order to reduce hazards in the event of afire.

TECHNIQUE

CONTAINMENT DIKES. . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

January 1990

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl mercaptan is a colorless to yellow flammable liquid that is highly volatile and has a strong offensive odor resembling skunk, decayed cabbage, and/or garlic at extremely low concentrations in air. It is used as an odorant in LPG and natural gas to provide a warning in the event of leaks and also has uses as an adhesive stabilizer and in making plastics, insecticides, pharmaceuticals, and antioxidants. Slightly soluble in water and lighter, ethyl mercaptan will form a floating surface slick on water that dissolves at a relatively slow rate while rapidly evaporating. Its flash point of approximately – 38°F indicates that the product is easily ignited under all ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7 pounds per gallon.

Ethyl mercaptan does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials, however; may evolve toxic fumes of sulfur oxides in contact with acids or acid fumes; and may be incompatible with a variety of other chemical substances. Toxicity by all potential routes of exposure is generally moderate but the volatility of the product indicates that high concentrations of ethyl mercaptan vapors may be present in air. Products of combustion may include highly toxic fumes of sulfur oxides such as sulfur dioxide as well as other toxic constituents.

If ethyl mercaptan is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.68–1.5 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, ether, acetone, and petroleum naphtha.
SpeciFic Gravity (Liquid): 0.839 at 68°F (20°C)
Boiling Point: 93.9–97.2°F (34.4–36.2°C) at 1 atm.
Melting Point: –234 to –227.9°F (–148 to –144.4°C)
Freezing Point: See melting point
Molecular Weight: 62.13
Heat of Combustion: –8300 cal/g
Vapor Pressure: 442 mm Hg (8.543 psia) at 68°F (20°C)
Flash Point: –38°F (–38.9°C), closed cup
Autoignition Temperature: 570–572°F (299–300°C)
Burning Rate: 5.7 mm/minute
Stability: Stable
Corrosiveness: Unavailable
Reactivity with Water: No reaction
Reactivity with Other Chemicals: May react violently or vigorously and possibly ignite in contact with calcium hypochlorite or other strong oxidizing materials; contact with acid or acid fumes may evolve highly toxic fumes of sulfur oxides; mercaptans in general are also usually reactive with alkaline earth metals, nitrides, peroxides, epoxides, strong reducing agents, and various other chemical substances.

IDENTIFICATION

Shipping Names: Ethyl mercaptan (USDOT and IMO)
Synonyms and Tradenames: Ethanethiol; ethyl sulfhydrate; ethylhydrosulfide; ethylthioalcohol; mercaptoethane; thioethyl alcohol; thioethanol
Chemical Formula: CH_3CH_2SH
Constituent Components (% each): 98.5% or more pure with remainder likely to contain other mercaptans and sulfides
49 STCC: 49 081 69
UN/NA Designation: UN2363
IMO Designation: 3.1, flammable liquid
Physical State As Shipped: Liquid
Physical State As Released: Liquid (boils at approx. 94–97°F)
Color of the Shipped Material: Colorless to yellow
Odor Characteristics: Like skunk, decayed cabbage, and/or garlic; very penetrating and persistent.
Common Uses: Leak warning odorant in LPG and natural gas; adhesive stabilizer; raw material or intermediate in making plastics, insecticides, pharmaceuticals, and antioxidants.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Extremely low; 100% odor recognition is as low as 1–2 parts per billion (ppb) in air for some unadapted persons.

Unusual Hazards: Highly volatile flammable liquid with heavier than air vapors that may persist in pits, hollows, and depressions. Offensive odor may travel very considerable distance from spill site.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.5 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in the immediate spill area and over some distances downwind. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid ethyl mercaptan may result in irritation. Contact of the eyes with liquid ethyl mercaptan may cause slight to moderate irritation.

Hazards of Inhalation: Exposure to ethyl mercaptan vapors in air may cause irritation of the eyes, nose, throat, and respiratory tract. Inhalation of higher concentrations may cause narcosis and central nervous system depression with symptoms including headache, nausea, increased respiration, weakness, incoordination, staggering gait, partial skeletal muscular paralysis, light to severe cyanosis, mild to heavy sedation, tremors, unconsciousness, respiratory paralysis, and possibly death. Exposures to near lethal levels in air may result in pulmonary edema that may be delayed in onset and that may also have severe consequences. Exposure of mice to 2770 ppm and rats to 4420 ppm in air for four hours resulted in death of 50% of the animals in laboratory experiments.

Hazards of Ingestion: Ethyl mercaptan is of relatively moderate oral toxicity. Effects of ingestion may resemble some of those of inhalation but also include the possibility of liver or kidney damage. Some effects may be delayed in onset. There is a possibility that aspiration into the lungs during vomiting may result in delayed in pulmonary edema and chemical pneumonitis with potentially severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 2.8%

Upper Flammable Limit: 18–18.2%

Behavior in Fire: Volatile flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fires.

Hazardous Combustion Products: Not well-defined but likely to include highly toxic sulfur oxides such as sulfur dioxide as well as carbon monoxide, carbon dioxide, and possibly other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

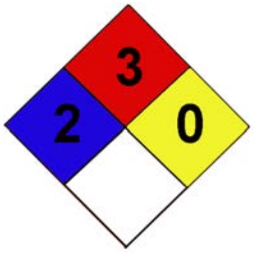
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. A maker of ethyl mercaptan lists PVC, neoprene, and butyl rubber as potentially compatible materials.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 25 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (25 ppm or less) or a chemical cartridge respirator with a full facepiece (25 ppm or less) within the use limitations of these devices.

2363

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, respiratory tract or skin; symptoms of central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Sources disagree on the proper response. Although one major authority makes the above recommendation, a maker of the product indicates that vomiting should not be induced. Seek immediate medical advice on this issue if possible, realizing that both courses of action pose various risks to the victim.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, Halon, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl mercaptan may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that ethyl mercaptan is a highly volatile flammable liquid that will boil at high ambient temperatures and that has heavier than air vapors. Note that tomato juice is reported to deodorize materials contaminated with this product.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl mercaptan spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Be advised, however, that ethyl mercaptan has an offensive odor at extremely low concentrations in air and that strong odors may be experienced at far downwind locations at concentrations that are well below those that cause significant toxic effects.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl mercaptan vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethyl mercaptan from contact with its airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of ethyl mercaptan vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethyl mercaptan may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethyl mercaptan may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, perlite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Even very low concentrations of ethyl mercaptan in water can cause taste or odor problems. Some or all of the oil spill type response measures that follow may not be effective where the product quickly leaves the water surface via evaporation and/or dissolution.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, or small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating ethyl mercaptan.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Commercial sorbent materials compatible with ethyl mercaptan may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1990

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl mercaptan is a colorless to yellow flammable liquid that is highly volatile and has a strong offensive odor resembling skunk, decayed cabbage, and/or garlic at extremely low concentrations in air. It is used as an odorant in LPG and natural gas to provide a warning in the event of leaks and also has uses as an adhesive stabilizer and in making plastics, insecticides, pharmaceuticals, and antioxidants. Slightly soluble in water and lighter, ethyl mercaptan will form a floating surface slick on water that dissolves at a relatively slow rate while rapidly evaporating. Its flash point of approximately – 38°F indicates that the product is easily ignited under all ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7 pounds per gallon.

Ethyl mercaptan does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials, however; may evolve toxic fumes of sulfur oxides in contact with acids or acid fumes; and may be incompatible with a variety of other chemical substances. Toxicity by all potential routes of exposure is generally moderate but the volatility of the product indicates that high concentrations of ethyl mercaptan vapors may be present in air. Products of combustion may include highly toxic fumes of sulfur oxides such as sulfur dioxide as well as other toxic constituents.

If ethyl mercaptan is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.68–1.5 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, acetone, and petroleum naphtha.

SpeciFic Gravity (Liquid): 0.839 at 68°F (20°C)

Boiling Point: 93.9–97.2°F (34.4–36.2°C) at 1 atm.

Melting Point: –234 to –227.9°F (–148 to –144.4°C)

Freezing Point: See melting point

Molecular Weight: 62.13

Heat of Combustion: –8300 cal/g

Vapor Pressure: 442 mm Hg (8.543 psia) at 68°F (20°C)

Flash Point: –38°F (–38.9°C), closed cup

Autoignition Temperature: 570–572°F (299–300°C)

Burning Rate: 5.7 mm/minute

Stability: Stable

Corrosiveness: Unavailable

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react violently or vigorously and possibly ignite in contact with calcium hypochlorite or other strong oxidizing materials; contact with acid or acid fumes may evolve highly toxic fumes of sulfur oxides; mercaptans in general are also usually reactive with alkaline earth metals, nitrides, peroxides, epoxides, strong reducing agents, and various other chemical substances.

IDENTIFICATION

Shipping Names: Ethyl mercaptan (USDOT and IMO)

Synonyms and Tradenames: Ethanethiol; ethyl sulfhydrate; ethylhydrosulfide; ethylthioalcohol; mercaptoethane; thioethyl alcohol; thioethanol

Chemical Formula: CH_3CH_2SH

Constituent Components (% each): 98.5% or more pure with remainder likely to contain other mercaptans and sulfides

49 STCC: 49 081 69

UN/NA Designation: UN2363

IMO Designation: 3.1, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid (boils at approx. 94–97°F)

Color of the Shipped Material: Colorless to yellow

Odor Characteristics: Like skunk, decayed cabbage, and/or garlic; very penetrating and persistent.

Common Uses: Leak warning odorant in LPG and natural gas; adhesive stabilizer; raw material or intermediate in making plastics, insecticides, pharmaceuticals, and antioxidants.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Extremely low; 100% odor recognition is as low as 1–2 parts per billion (ppb) in air for some unadapted persons.

Unusual Hazards: Highly volatile flammable liquid with heavier than air vapors that may persist in pits, hollows, and depressions. Offensive odor may travel very considerable distance from spill site.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.5 ppm over each *8* hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in the immediate spill area and over some distances downwind. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid ethyl mercaptan may result in irritation. Contact of the eyes with liquid ethyl mercaptan may cause slight to moderate irritation.

Hazards of Inhalation: Exposure to ethyl mercaptan vapors in air may cause irritation of the eyes, nose, throat, and respiratory tract. Inhalation of higher concentrations may cause narcosis and central nervous system depression with symptoms including headache, nausea, increased respiration, weakness, incoordination, staggering gait, partial skeletal muscular paralysis, light to severe cyanosis, mild to heavy sedation, tremors, unconsciousness, respiratory paralysis, and possibly death. Exposures to near lethal levels in air may result in pulmonary edema that may be delayed in onset and that may also have severe consequences. Exposure of mice to 2770 ppm and rats to 4420 ppm in air for four hours resulted in death of 50% of the animals in laboratory experiments.

Hazards of Ingestion: Ethyl mercaptan is of relatively moderate oral toxicity. Effects of ingestion may resemble some of those of inhalation but also include the possibility of liver or kidney damage. Some effects may be delayed in onset. There is a possibility that aspiration into the lungs during vomiting may result in delayed in pulmonary edema and chemical pneumonitis with potentially severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 2.8%

Upper Flammable Limit: 18–18.2%

Behavior in Fire: Volatile flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fires.

Hazardous Combustion Products: Not well-defined but likely to include highly toxic sulfur oxides such as sulfur dioxide as well as carbon monoxide, carbon dioxide, and possibly other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

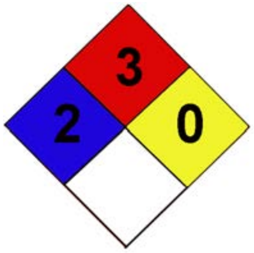
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. A maker of ethyl mercaptan lists PVC, neoprene, and butyl rubber as potentially compatible materials.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above *25* ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (25 ppm or less) or a chemical cartridge respirator with a full facepiece (25 ppm or less) within the use limitations of these devices.

2363

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, respiratory tract or skin; symptoms of central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Sources disagree on the proper response. Although one major authority makes the above recommendation, a maker of the product indicates that vomiting should not be induced. Seek immediate medical advice on this issue if possible, realizing that both courses of action pose various risks to the victim.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, Halon, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of ethyl mercaptan may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that ethyl mercaptan is a highly volatile flammable liquid that will boil at high ambient temperatures and that has heavier than air vapors. Note that tomato juice is reported to deodorize materials contaminated with this product.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Ethyl mercaptan spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Be advised, however, that ethyl mercaptan has an offensive odor at extremely low concentrations in air and that strong odors may be experienced at far downwind locations at concentrations that are well below those that cause significant toxic effects.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl mercaptan vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of ethyl mercaptan from contact with its airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of ethyl mercaptan vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ethyl mercaptan may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained ethyl mercaptan may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, perlite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Even very low concentrations of ethyl mercaptan in water can cause taste or odor problems. Some or all of the oil spill type response measures that follow may not be effective where the product quickly leaves the water surface via evaporation and/or dissolution.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, or small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

ETHYL MERCAPTAN
Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating ethyl mercaptan.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Commercial sorbent materials compatible with ethyl mercaptan may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

ETHYL METHACRYLATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Ethyl methacrylate is a colorless flammable liquid with a sharp, unpleasant, acrid and fruity odor. It is slightly soluble in water and somewhat lighter, so it may form a floating surface slick that slowly dissolves in water while evaporating. It can be easily ignited under moderate to high ambient temperature conditions. At or above its flash point, vapors of ethyl methacrylate may be heavier than air, may persist for a time in low areas, and may travel some distance to a source of distance and flash back. Accumulation of such vapors in confined spaces such as buildings or sewers may explode if ignited. The product weighs approximately 7.63 pounds per gallon.

Ethyl methacrylate does not react with water or many other common materials and is stable in normal transportation, provided it is inhibited to prevent self-polymerization which may result in violent or explosive rupture of closed containers. Such polymerization can occur if the product is exposed to excessive heat, excessive light, or various contaminants; has an insufficient concentration of inhibitor present; or is stored in the absence of air. The substance is reported to be incompatible with strong oxidizing agents (including pure oxygen), strong acids, and strong bases. It is also likely to be incompatible in some fashion with members of many other major families of chemicals and may attack many forms of plastics, rubber, and coatings. Toxicity of the substance is low to moderate by all routes of exposure. Products of combustion are reported to include acrid smoke and irritating fumes.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if ethyl methacrylate is leaking or otherwise venting from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble.

Solubility in Other Chemicals: Soluble in acetone, ether, and ethyl alcohol.

Specific Gravity (Liquid): 0.9135 - 0.9151 at 68°F *(20°C).*

Boiling Point: 242.6 - 246.2°F (117 - 119°C) at 1 atm.

Melting Point: Below - 58°F (- 50°C).

Freezing Point: See melting point.

Molecular Weight: 114.14.

Heat of Combustion: - 7,040 cal/g.

Vapor Pressure: 15 mm Hg (0.2899 psia) at 68°F (20°C).

Flash Point: 60 - 80°F (15.6 - 26.7°C), closed-cup; 68 - 85°F (20 - 29.4°C), open-cup.

Autoignition Temperature: 740 or 771°F (393 or 411°C).

Burning Rate: 4.6 mm/minute.

Stability: Stable in normal transportation when inhibited. Excessive heat, excessive exposure to sunlight (ultraviolet light) or x-rays, or contamination by certain chemical substances may cause a potentially violent self-polymerization reaction that may result in violent or explosive rupture of a closed container.

Corrosiveness: Suitable materials are reported to include aluminum, glass, and types 304 and 316 stainless steel. It may be corrosive to mild steel. It may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: The oxygen found in air helps to inhibit polymerization but ethyl methacrylate is not compatible with pure oxygen. Contaminants that initiate violent polymerization reactions include azoisobutyronitrile, dibenzoyl peroxide, di-tert-butylperoxide, and potentially a wide variety of other substances including oxidizers, free radical initiators, and other organic peroxides. It is said to be otherwise incompatible with strong acids and strong bases.

IDENTIFICATION

Shipping Names: Ethyl methacrylate.

Synonyms and Tradenames: Ethyl alpha-methyl acrylate; ethyl 2-methacrylate; ethyl methacrylate monomer; ethyl methyl acrylate; ethyl 2-methyl-2-propenoate; methacrylic acid, ethyl ester; 2-methyl-2-propen-oic acid, ethyl ester; and 2-propenoic acid, 2-methyl-, ethyl ester.

Chemical Formula: $CH_2{=}C(CH_3)COOCH_2CH_3$.

Constituent Components (% each): Typically 98% or more pure with the remainder consisting of methacrylic acid, methyl methacrylate, other ester adducts, and/or traces of water.

UN/NA Designation: UN2277.

IMO Designation: 3, flammable.

Physical State As Shipped: Liquid.

Physical State As Released: Usually liquid; some products may solidify at very cold ambient temperatures.

Color of the Shipped Material: Colorless.

Odor Characteristics: Sharp, unpleasant, acrid, and fruity.

Common Uses: Used to make polymers and plastics (including Plexiglass); used to make paints, coatings, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

ETHYL METHACRYLATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Data not available. Thresholds in the range of 0.19 to 0.21 ppm have been reported for the similar methyl methacrylate.

Unusual Hazards: Various conditions may initiate an exothermic self-polymerization reaction that may result in violent or explosive rupture of a closed container, potentially releasing large amounts of hot unpolymerized vapors and mists into the atmosphere if a source of ignition is not encountered. Vapors may possibly be uninhibited and form polymers in vents or flame arresters, resulting in stoppage of flow.

Short Term Exposure Limit (STEL): Not established by a recognized authority. One manufacturer recommends a STEL of 75 ppm for 15 minutes in its MSDS.

Time Weighted Average (TWA) Limit: Not established by a recognized authority. One major manufacturer recommends a TWA of 25 ppm in its MSDS while another suggests a TWA of 50 ppm; both over each 8 hours of a 40 hour work week.

Ceiling (C) Limit: Not established

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; oxygen-free atmospheres in containers; exposure of the product to light or x-rays; contamination; long-term storage.

HEALTH HAZARDS

Public Health Hazards: The odor of this chemical may be smelled far further downwind than it is harmful in short-term exposures. One hazard is from inhalation of the vapor concentrations that may be present in air in the spill area and over some distance downwind due to a discharge. Of great concern would be a situation in which an uncontrolled exothermic self-polymerization reaction takes place in a container not exposed to fire or another source of ignition and the container either ruptures violently or otherwise spews out massive amounts of hot vapors and mists into the atmosphere. Be advised that this material is a suspected teratogen and mutagen.

Hazards of Skin or Eye Contact: Contact of the eyes with liquid ethyl methacrylate may result in moderate irritation, discomfort, lacrimation, and blurring of vision. Vapors of this substance are also irritating to the eyes. Contact of the skin with the liquid may result in slight irritation, discomfort and a possible rash. Analogy with other acrylic monomers indicates the possibility that severe irritation, inflammation, and possibly even severe tissue damage may occur if the liquid is confined against the skin such as by clothing for a prolonged period of time. The skin of some susceptible people may become sensitized to ethyl methacrylate such that they become allergic. Liquid ethyl methacrylate can be absorbed through intact skin but at such a slow rate that a single exposure, unless massive and prolonged, is not likely to result in significant intoxication. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Vapors and mists of ethyl methacrylate irritate the nose, throat, and upper respiratory passages. Excessive exposures may cause symptoms which variably include coughing, wheezing, laryngitis, dizziness, headache, confusion, lightheadedness, incoordination, weakness, drowsiness, nausea, vomiting, shortness of breath, rapid respiration, possibly lowered blood pressure possibly decreased heart rate, unconsciousness, and possibly death in very extreme cases (as a result of respiratory failure). Repeated exposures may cause slightly increased red blood cell counts. Be advised that other acrylic monomers have been known to cause pronounced lung irritation or pulmonary edema upon overexposure, the latter of which is often delayed in onset. The lowest concentration of ethyl methacrylate vapors that resulted in the death of rats from 3 hour exposures was 15,000 ppm; 50% of rats died when exposed to 8300 ppm for 4 hours. The saturated vapor concentration directly over a pool of liquid ethyl methacrylate is about 19,735 ppm at 68°F (20°C). Much greater concentrations and downwind hazards may be experienced, however, if a container in which a self-polymerization reaction is taking place ruptures or otherwise vents large amounts of hot vapors and mists into the atmosphere and these do not encounter a source of ignition.

Hazards of Ingestion: Ethyl methacrylate is of low to moderate toxicity by ingestion. Excessive intake of the liquid may cause many of the effects of overexposure by inhalation as well as and including irritation of the mouth and stomach, corrosion of the walls of the stomach, weakness, labored and irregular respiration, a drop in blood pressure, unconsciousness and possibly death as a possible result of respiratory failure when large amounts have been ingested. The single oral doses required to kill 50% of rats are in the range of 13.3 to 14.8 grams of ethyl methacrylate per kilogram of an animal's body weight. One authority estimates a human fatal dose of 5.4 g/kg.

FIRE HAZARDS

Lower Flammable Limit: 1.8%.

Upper Flammable Limit: Saturated vapor concentration; temperature unspecified.

Behavior in Fire: Flammable liquid. May possibly generate large amounts of flammable vapors upon release. Such vapors may travel some distance to a source of ignition and flash back. Heat can cause a violent self-polymerization reaction with rapid release of energy, causing sealed containers to rupture violently or explosively and to possibly rocket.

Hazardous Combustion Products: Not well-defined; simply reported to produce acrid smoke and irritating fumes including but not limited to carbon monoxide and carbon dioxide.

2277

ETHYL METHACRYLATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS *(CONTINUED)*
EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors from liquid ethyl methacrylate at or above its flash point are ignited in a confined area. Containers may rupture violently or explosively and possibly rocket in a fire. There is a possibility that contact with certain other chemicals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, vapor-tight safety goggles, and other impervious and resistant clothing. Various authorities recommend use of fully encapsulating suits with self-contained breathing apparatus (SCBA) for protection during fire fighting. Compatible materials for ethyl methacrylate itself may include butyl rubber and polyvinyl alcohol. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: For unknown concentrations, fire fighting, or general use, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). A gas mask with chin-style or front or back mounted organic vapor canister or a chemical cartridge respirator with a full facepiece and organic vapor cartridges) may be adequate for "normal" operations at times within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues; coughing, drowsiness, headache, incoordination, weakness, nausea, vomiting, unusual breathing, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Limited data are available. Get medical attention immediately or advice from physician as to whether water should be administered and/or vomiting induced. If vomiting is induced or occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective. Regular or alcohol foam may be effective to some degree.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to heat. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Ethyl methacrylate discharges may expose downwind areas to toxic and possibly flammable

ETHYL METHACRYLATE
Class 3 (Flammable Liquid)

AIR SPILL *(CONTINUED)*

concentrations over considerable distances in some cases, particularly if relatively large amounts have spilled in warm weather. Of the highest concern is a situation in which an uncontrolled self-polymerization reaction takes place in a container not exposed to fire or another source of ignition and the container ruptures suddenly or otherwise spews out massive amounts of hot vapors and mists into the atmosphere, in which case evacuation distances may possibly have to be very considerable.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION . . . Liquid ethyl methacrylate may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in certain cases to simply monitor the situation until the spilled product is removed, particularly if relatively small amounts have spilled in cool weather and there is no danger of a polymerization reaction taking place in a large container of the substance.

CONSEQUENCE

Hazardous levels of ethyl methacrylate may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately d***ownwind.***

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ethyl methacrylate vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of ethyl methacrylate from contact with its airborne vapors.

MITIGATION

Where deemed necessary, contain contaminated water and remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam (either regular or alcohol type) applied to the surface of liquid pools may slow the release of ethyl methacrylate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid ethyl methacrylate may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fare-hose runoff' or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

LAND SPILL *(CONTINUED)*

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Improperly designed or contaminated equipment could contribute to the risk of a dangerous self-polymerization reaction taking place within the recovery equipment.

MITIGATION

Use equipment compatible with the spilled product. Ensure it is suitable for recovery and storage of ethyl methacrylate.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL. . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors present in the area may be ignited by motorized equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid ethyl methacrylate will float on the surface of the water while simultaneously evaporating at some slow rate into the atmosphere and dissolving at a fairly slow rate into the water. Note that potentially flammable and toxic vapors may evolve from the water surface for a time and travel in the downwind direction as the contaminated water moves downstream.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

ETHYL METHACRYLATE
Class 3 (Flammable Liquid)

WATER SPILL *(CONTINUED)*

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating liquid ethyl methacrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose a hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with ethyl methacrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources. Note that noncombustible sorbents are preferred when available to reduce hazards in the event of a fire.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

FERRIC CHLORIDE SOLUTION
Class 8 (Corrosive Material)

GENERAL INFORMATION

Ferric chloride is a greenish black, yellow orange, or brown solid that may be shipped as a brownish orange acidic solution in water. The solution has a faint odor of hydrochloric (muriatic) acid and is used as a flocculant, catalyst, pigment, etching agent, feed additive, and mordant. It is fully soluble in water and is not flammable. It weighs approximately 11.6 pounds per gallon, but this may vary with the amount of ferric chloride in solution, as may other properties given in this guide (given for greater than 50% solutions.)

Ferric chloride solutions do not react with water and are stable in normal transportation. They are corrosive to most metals and violently reactive with certain chemicals. They are also irritating and possibly corrosive to bodily tissues. Toxic chlorides may be evolved when solutions are heated.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol
Specific Gravity (Liquid): 1.396 at 86°F (30°C)
Boiling Point: 599°F (315°C)
Melting Point: below –58°F (–50°C)
Freezing Point: below –58°F (–50°C)
Molecular Weight: 162.21 (ferric chloride)
Heat of Combustion: Not flammable
Vapor Pressure: Unavailable
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: Corrosive to most metals
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts violently with allyl chloride, sodium, potassium, and ethylene oxide; also reacts with acids, sulfur, and oxidizable materials.

IDENTIFICATION

Shipping Names: Ferric chloride solution (USDOT and *IMO)*
Synonyms and Tradenames: Iron trichloride; iron (III) chloride; iron chloride; iron muriate.
Chemical Formula: $FeC1_3$ (ferric chloride)
Constituent Components(% each): Ferric chloride in water
49 STCC: 49 323 42; 49 323 43
UN/NA Designation: UN2582
IMO Designation: 8, corrosive
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Orange-brown solution
Odor Characteristics: Faint odor of hydrochloric acid; sharp, pungent, irritating.
Common Uses: Flocculant for sewage and industrial waste; catalyst; pigment; etching agent for engraving, photography, electronics; feed additive; oxidizing agent; mordant.

FERRIC CHLORIDE SOLUTION
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

***Threshold Odor* Concentration:** Unavailable
Unusual Hazards: Somewhat corrosive nonflammable liquid.
Short Term Exposure Limits (STEL): Unavailable
Time Weighted Average (TLV-TWA): Unavailable
Conditions to Avoid: Excessive heat; contact with incompatible materials; runoff to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Ferric chloride solutions are irritating and somewhat corrosive to bodily tissues via all routes of exposure.
Hazards of Skin or Eye Contact: Contact with ferric chloride solutions may result in irritation or possibly burns of the skin or eyes.
Hazards of Inhalation: Breathing ferric chloride dust (and presumably vapors or mists from solutions) may cause irritation of the nose and throat and coughing or difficult breathing.
Hazards of Ingestion: Ingestion may result in irritation of the mouth and stomach.

FIRE HAZARDS

Lower Flammable Limit: Not flammable
Upper Flammable Limit: Not flammable
Behavior in Fire: May evolve toxic chlorides. Some chance that containers may rupture due to steam pressure.
Hazardous Combustion Products: May evolve toxic chlorides such as hydrogen chloride fumes when heated.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable
Upper Explosive Limit: Not flammable
Explosiveness: Some chance that containers may rupture due to steam pressure.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Mist respirators may be adequate for normal circumstances within the use limitations of these devices.

FIRST AID

Nonspecific symptoms: Irritation of bodily tissues.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists.
***First Aid for* Ingestion:** If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

2582

FERRIC CHLORIDE SOLUTION
Class 8 (Corrosive Material)

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in adverse impacts on industrial processes.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Ferric chloride solution, usually, will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ferric chloride solution in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to ferric chloride solution vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain ferric chloride solution from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid ferric chloride solution may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

FERRIC CHLORIDE SOLUTION
Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Ferric chloride solution may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained ferric chloride solution may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

FERRIC CHLORIDE SOLUTION
Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

August 1997

FERROUS CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

GENERAL INFORMATION

Ferrous chloride solution is a green solution with a slight acrid odor used in dyeing, metallurgy, pharmaceutical preparations, manufacture of ferric chloride, and sewage treatment. It is easily soluble in water and methanol. It has a high boiling point of 104.4-121.1°C (220-250°F). This material is normally stable, however it is incompatible with materials such as oxidizing agents, alkali materials, metals, sodium, potassium and ethylene oxide and in conditions of extreme heat, air, light and moisture.

Ferrous chloride solution is corrosive and toxic to tissues and mucous membranes. It is corrosive and irritating to the skin and can cause inflammation and blistering. It is also corrosive and irritating to the eyes and can cause corneal damage or blindness. Inhalation is toxic to the lungs, can cause irritation to the respiratory tract and can result in unconsciousness and possibly death. Ingestion can cause irritation to the gastrointestinal tract and possible metabolic acidosis, coma and eventually death.

Ferrous chloride is not flammable. Although when heated it can emit fumes of hydrochloric acid. In situations where a fire exists, it is recommended to use extinguishing agents appropriate for the source of the surrounding fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Easily soluble
Solubility in Other Chemicals: Soluble in methanol.
Specific Gravity (Water=1): 1.24-1.40
Vapor Density(Air=1): 4.4
Boiling Point: 104.4-121.1°C (220-250°F)
Melting Point: <0°C (32°F)
Freezing Point: See Melting Point
Molecular Weight: 126.75
Evaporation Rate (Ether=1): >1
Vapor Pressure: Low
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable Limits: Not flammable
Stability: Stable.
Polymerization Potential: May not occur
pH: .1-1.5
Corrosiveness: Non-corrosive in presence of glass.
Reactivity and Incompatibility: Incompatible with oxidizing agents, alkali materials, metals, sodium, potassium and ethylene oxide. Will react with extreme heat, air, light and moisture.
Reactivity with Water: Will absorb water.

IDENTIFICATION

Shipping Name(s): Ferrous chloride, solution (USDOT); Corrosive liquid, acidic, inorganic, n.o.s. (IMO)
Synonyms and Tradenames: Ferrous chloride; Iron chloride; Iron (II) chloride; Iron (2+) chloride; Iron dichloride
CAS Registry No: 7758-94-3.
Chemical Formula: $FeCl_2$ in H_2O
Constituent Components (% each): 27-35% ferrous chloride; 0.2-2.5% hydrochloric acid; 65-73% water.
UN/NA Designation: NA1760 (USDOT); UN3264 (IMO)
IMO Designation: 8
RTECS Number: NO5400000
NFPA 704 Hazard Rating: 2 (Health): 0 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Green solution
Odor Characteristics: Slight acrid odor
Reportable Quantity: See appendix I
Common Uses: Mordant in dyeing; metallurgy; pharmaceutical preparations; manufacture of ferric chloride; sewage treatment.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

FERROUS CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

*Also 3264

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Material is corrosive and toxic to tissues and mucous membranes. It is irritating to the eyes, skin, respiratory tract and gastrointestinal tract. Contact can cause severe skin reactions, corneal damage, blindness, lung damage and death.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1mg/m^3

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Avoid oxidizing agents, sodium, potassium, ethylene oxide and extreme heat, air and moisture.

HEALTH HAZARDS

Potential Health Hazards: Ferrous chloride is corrosive and toxic to tissues and mucous membranes. Eye contact can produce corneal damage and blindness. Material can cause irritation to the skin, eyes, respiratory tract and gastrointestinal tract. In cases of severe over exposure, lung damage and death can result.

Hazards of Skin or Eye Contact: Material is corrosive and irritating to the skin and can cause inflammation and blistering. Contact with eyes can be corrosive and irritating and can result in corneal damage or blindness. Damage to skin or eyes is function of length of tissue contact.

Hazards of Inhalation: Inhalation of vapors from this material can produce irritation to the respiratory tract. Symptoms include burning, sneezing and coughing. Material is toxic to lungs and mucous membranes and in severe over exposure can cause lung damage, choking, unconsciousness and even death.

Hazards of Ingestion: Ingestion can cause irritation to the gastrointestinal tract and possible delayed metabolic acidosis, coma and eventual liver damage.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Does not burn.

Hazardous Decomposition Products: When heated emits fumes of hydrochloric acid.

EXPLOSION HAZARDS

Explosive Potential: Ferrous chloride is non combustible.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels of their use. Protection by air purifying resperators is limited.

FIRST AID

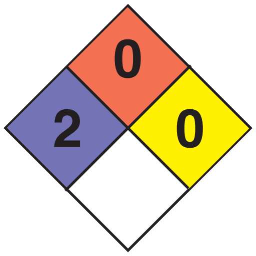
Nonspecific Symptoms: Ferrous chloride is corrosive to tissue and mucous membrane and can cause burns or blistering. Material is toxic to lungs and can cause coughing or wheezing and in severe cases can cause lung damage and death. If exposed to the eyes it can cause abnormal vision and could result in blindness. If ingested it can cause gastrointestinal irritation which can result in metabolic acidosis, coma or liver damage.

1760 *

*Also 3264

FERROUS CHLORIDE, SOLUTION

Class 8 (Corrosive Material)



First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, wash with large amounts of soap and water for 15 minutes. Remove contaminated clothing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large quantities of water if patient is conscious. Do not induce vomiting without medical advice. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Since ferrous chloride solution does not burn, use extinguishing agents appropriate for surrounding fire.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water to protect exposures or prevent containers from failing. Do not flood spill material with water since it does not significantly reduce the pH. Fight fire from maximum distance to disperse vapors and protect personnel. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain toxic material.

SPILL RESPONSES

General Information: Ferrous chloride is a highly toxic and corrosive solid that may cause environmental contamination. Confine and contain runoff. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Prevent substance from entering sewers, waterways and confined spaces. Underflow dams are not an effective means to dike material since it is soluble with water and is heavier than water. As a result, recovery efforts from water borne releases are difficult. Runoff may be toxic and corrosive. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

FERROUS CHLORIDE, SOLUTION

Class 8 (Corrosive Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the immediate area in all directions if a bulk container of the liquid is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind if there is a large spill or the material is involved in a fire.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if concentrations exist and when conditions are safe to reenter the area. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted.

TECHNIQUE

MONITOR THE SITUATION . . . Usually ferrous chloride, solution will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

FERROUS CHLORIDE, SOLUTION
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

FERROUS CHLORIDE, SOLUTION
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

July, 1994

FLUORINE, COMPRESSED*
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Fluorine is an extremely reactive gas and is a member of the chemical group known as halogens. It is pale yellow in color and has a sharp, penetrating odor. It is extremely corrosive to most living tissues and is a potent oxidizer. Fluorine will react with virtually any organic material, most metals and silica compounds. While fluorine is not flammable, it will support and accelerate the combustion of fuels. Fluorine reacts violently with water to form hydrogen fluoride and hydrofluoric acid. Because of fluorine's reactivity and pressure characteristics, stopping fluorine leaks is difficult. Only materials inert to the effects of fluorine such as thread sealing tapes and plugging devices can be used. Because fluorine exists as a gas, there is a significant risk to downwind exposures. The gas is heavier than air and may accumulate in low lying areas or confined spaces. Handling fires where fluorine is involved is also difficult. Most fire fighting agents such as carbon dioxide and foam, including alcohol and protein, are oxidized in the presence of fluorine and may simply add fuel to the fire.

Fluorine reacts very quickly with tissues and will cause severe burns on exposure. On contact with skin tissues, fluorine will quickly hydrolyze to hydrofluoric acid. Burns to the skin will typically take a yellowish stain. Residual fluorine on the skin will continue to cause damage until washed with copious amounts of water and/or neutralized. Fluorine gas may contaminate water used in fire suppression or vapor control activities. In the event that a fluorine gas container is submerged and leaking, the gas will react with water, principally forming hydrofluoric acid. To address these concerns, refer to the **Hydrofluoric acid,** *Emergency Action Guide.*

Fluorine is an important element in the manufacture of a wide variety of commonly used chemicals. It is used in the manufacture of pharmaceuticals and plastics, including teflon. It is also used in the production of refrigerant gasses such as R-12 and R-22 found in air conditioners, and in the manufacture of halon, used in fire suppression systems.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts violently, potentially explosively.
Solubility in Other Chemicals: Reacts with standard solvents.
Specific Gravity (Liquid): Gas.
Vapor Density (Air=1): 1.31
Boiling Point: - 188°C (- 306.4°F)
Melting Point: - 220°C (- 364°F)
Freezing Point: - 220°C (- 364°F)
Molecular Weight: 37.99
Heat of Combustion: Non-flammable.
Vapor Pressure: Gas. Flash Point: Non-flammable.
Autoignition Temperature: Non-flammable.
Burning Rate: Non-flammable, accelerates and supports combustion of fuel materials.
Stability: Normally stable, will not polymerize.
Corrosiveness: Highly corrosive to living tissues and most metals.
Reactivity with Water: Violent reaction, evolving heat. Products include hydrofluoric acid and hydrogen fluoride.
Reactivity with Other Chemicals: Extremely strong oxidizer, probably the most potent oxidizer known. Reacts with most organic materials, silicon materials (glass) and metals. Reactions can be violent and/or explosive. May oxidize fire fighting agents such as CO_2, and foams.

IDENTIFICATION

Shipping Names: Fluorine, compressed.
Synonyms and Tradenames: Fluorine; CAS 7782-41-4.
Chemical Formula: F_2
Constituent Components (% each): 99% fluorine
UN/NA Designation: UN1045
IMO Designation: 2.3, poisonous gas.
Physical State as Shipped: Compressed gas.
Physical State as Released: Gas.
Color of the Shipped Material: Yellowish gas.
Odor Characteristics: Sharp, pungent, irritating, highly corrosive.
Common Uses: The manufacture of pharmaceuticals, plastics including teflon, refrigerant gasses such as R-12 and R-22, halon, water treatment chemicals and a variety of other materials.

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*Reportable Quantity (RQ) established. Refer to appendix 1.

**FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616**

FLUORINE, COMPRESSED
Division 2.3 (Poison Gas)

Square background
applicable to rail cards.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 3 ppm (6 mg/m^3)

Unusual Hazards: Extremely corrosive to living tissue, oxidizes most organic material, supports combustion, may react with carbon dioxide or foam fire suppression agents.

Short Term Exposure Limits (STEL): 2 ppm (4 mg/m^3) (ACGIH)

Time Weighted Average (TLV-TWA): 0.1 ppm (0.2 mg/m^3) OSHA PEL - TWA.

Conditions to Avoid: Contact with water and other fire fighting chemicals, incompatible materials (includes most organics and metals); runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Extremely corrosive to tissues. Contact with vapors may result in severe burns to skin and respiratory system. Acts quickly to produce damage.

Hazards of Skin and Eye Contact: Due to the highly reactive nature of fluorine gas, any direct contact with skin and eye tissue will probably produce some degree of injury. Eye exposure can result in severe burns to eye tissue. Extent and duration of exposure will determine the severity of the injury which could result in permanent blindness. Severe acid bums to the skin are likely to result from direct fluorine exposures. Burns may be deep, penetrating below the skin depending on the nature of the exposure. Fluorine burns will typically discolor skin providing a yellowish stain around the contact areas.

Hazards of Inhalation: Severe respiratory irritant. In high concentrations, respiratory exposures may quickly become incapacitating. Corrosive to respiratory mucous membranes. Symptoms include coughing, wheezing, excessive salivation and mucous formation. May progress to acute pulmonary edema and chemical pneumonia. Inhalation exposures may be fatal depending on the concentration and duration of exposure. Burns may progress even after removal from exposures due to the formation of acid fluorine residuals.

Hazards of Ingestion: Ingestion of fluorine is highly unlikely given the fact that fluorine exists in gas form only.

FIRE HAZARDS

Lower Flammable Limit: Non-flammable.
Upper Flammable Limit: Non-flammable.

Behavior in Fire: Potent oxidizer, may react with most organics and cause ignition. Fluorine atmospheres will support combustion. Containers may rupture violently in afire due to over-pressurization. Will generate large quantities of gas upon release.

Hazardous Combustion Products: Non-flammable, related to fuel involved. Fluoride formation with fuel is likely and such products are generally toxic. Formation of hydrogen fluoride and oxygen difluoride likely in fire situations.

EXPLOSION HAZARDS

Explosiveness: Fluorine is non-flammable and non-explosive. As a strong oxidizer, it may ignite or react violently with most organic materials. Explosive properties will depend on the nature of the fuel involved. May react explosively on contact with a variety of materials such as: ammonium hydroxide, carbon tetrachloride, cellulose, chlorine dioxide, hydrogen and water. Containers may rupture violently in a fire due to over-pressurization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Full chemical protective equipment is necessary when dealing with fluorine releases. Equipment should protect from all direct contact with fluorine gas. Fully encapsulating suits made of compatible material are appropriate for most spill situations. Fluorine will attack glass. Neoprene, butyl rubber, and polyvinyl chloride (PVC) have been reported as suitable materials of construction.

Respiratory Protection: Full respiratory protection. Positive pressure self contained breathing apparatus or supplied air systems with full facepiece (or equivalent) are recommended for handling spills and fires involving fluorine.

1045

FLUORINE, COMPRESSED
Division 2.3 (Poison Gas)

FIRST AID

Nonspecific Symptoms: Severe burns to any tissues involved. Eye contact may result in permanent damage or blindness. Severe corrosion of respiratory tissues, coughing, wheezing, choking, pulmonary edema, and chemical pneumonia. Symptoms may progress after removal from exposure due to residual contamination. Pulmonary symptoms may continue to develop after removal from exposure and victims should be observed for development/progression of pulmonary edema and delayed chemical pneumonia.

First Aid For Inhalation: Remove victim to fresh air. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure resulting in increased respiratory distress with time. Symptoms of pulmonary edema and chemical pneumonia may continue to develop for some time (1-2 days) after exposure. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Severe exposures may result in permanent eye damage or blindness. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance immediately. To neutralize fluorine residues on exposed skin, calcium gluconate, gel or slurry, in glycerin or water will bind active fluoride on skin limiting the extent of the burn. A preparation of 20% magnesium sulfate, 6% magnesium oxide, 18% glycerol, 55% water, and 1 - 2% procaine hydrochloride applied to skin as a paste has also been suggested. Finally, a simple preparation of 20% magnesium oxide in glycerin applied to the burned skin area has been reported as effective.

First Aid for Ingestion: Material is a gas and ingestion is highly unlikely.

FIRE RESPONSE

Extinguishing Materials: Non-flammable.

Extinguishing Techniques: Fluorine is non-flammable. Extinguishing techniques will be based on the fuel involved. Caution should be exercised as fluorine is reactive with water and extinguishing agents. Carbon dioxide and foams, may be oxidized by fluorine gas. Intact containers containing fluorine may rupture if exposed to fire due to increased gas pressure or thermal failure of container material. If intact containers are involved in fire, cool with water, from a safe distance and from the side of the container.

SPILL RESPONSES

General Information: Seek expert assistance. Spills involving fluorine will be in the form of leaking, compressed gas. Its highly reactive nature dictates that extreme caution be used when dealing with fluorine releases. Compatible materials must be used when dealing with fluorine. Fluorine is corrosive to most metals. Containers, transfer lines or other product handling equipment must be passivated prior to being used in fluorine service. Passivation is a special treatment process which protects metals from the effects of fluorine.

The principal health threat is from direct exposure to fluorine gas. Spills contaminating land surfaces will likely result from fluorine contaminated runoff from fire fighting activities. Water spills are likely from contaminated runoff or the release of fluorine gas from a submerged container. Once incorporated in runoff or water, fluorine will react to form hydrofluoric acid. Contaminated water will become acidic and the pH will depend on the amount of contaminant. Fluorine gas is denser than air and vapors may accumulate in low lying areas and confined spaces. Vapors may be controlled with water fog or mist spray. Do not spray water directly on the leak as this may help accelerate the release rate.

FLUORINE, COMPRESSED
Division 2.3 (Poison Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Fluorine releases may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Seek expert assistance. Working with fluorine and fluorine handling equipment requires specialized training. Stop leak if without risk and if proper equipment and trained personnel are available. Allow vapors and gas to dissipate completely before reentering spill area without special protective gear.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog applied to fluorine gas may accelerate its dispersal in the atmosphere. Fluorine gas will likely react with water to form hydrofluoric acid and hydrogen fluoride.

CONSEQUENCE

Water runoff may contain levels of hydrofluoric acid from contact with fluorine gas. Water will become acidic and the pH will depend on the levels of acid generated. High levels of hydrofluoric acid in solution will pose a significant hazard. Refer to the **Hydrofluoric acid, *Emergency Action Guide***, for further information.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Refer to the **Hydrofluoric acid, *Emergency Action Guide***, for further information.

LAND SPILL

Fluorine is a gas and will not form spills on land. Water runoff from fire fighting or air spill response may be contaminated with hydrofluoric acid depending on the level of exposure. If runoff is contaminated, refer to the **Hydrofluoric acid, *Emergency Action Guide***, for safety and response information. 1

WATER SPILL

Fluorine is a gas and will not form spills in water unless gas is release from submerged tank. Fluorine will react with water to form hydrofluoric acid and hydrogen fluoride. Reaction is likely to be violent. Hydrofluoric acid contaminated water may require further response. Refer to the **Hydrofluoric acid, *Emergency Action Guide***, for safety and response information.

March 1995

FORMALDEHYDE SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid or Class 9 (Miscellaneous Hazardous Material)

GENERAL INFORMATION

Formaldehyde is a colorless gas with a pungent irritating odor similar to odors from hay or straw. It is normally shipped as a 30-50% solution in water (also called formalin) with 0-15% methyl alcohol and is used in making disinfectants, embalming fluids, synthetic resins, artificial silk and textiles, dyes and inks, and a wide variety of other products and chemicals. Its flash point will vary with the specific composition of the solution but is typically in excess of 100°F. Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions if ignited. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The solution weighs approximately 9.2 pounds per gallon.

Formaldehyde does not react with water or many common materials and is stable in normal transportation. It is reactive with various chemicals and may be corrosive to steel, copper, and copper alloys. Although pure formaldehyde readily polymerizes with various organic materials, commercially available solutions contain methanol to inhibit such reactions. The product is highly irritating by the various routes of potential exposure and is suspected as being a human carcinogen in chronic exposures. Products of combustion may include unburned formaldehyde as well as other toxic products of organic substances. The properties described below are for commercial solutions unless noted otherwise.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, chloroform, and ether

Specific Gravity (Liquid): Approx 1.1 at 77°F (25°C)

Boiling Point: Approx 206-214°F (96.7-101.1°C) at 1 atm.

Melting Point: Unavailable

Freezing Point: Unavailable

Molecular Weight: 30.03 for formaldehyde

Heat of Combustion: -4543 cal/g at 77°F (25°C)

Vapor Pressure: 1-1.3 mm Hg (0.019-0.025 psia) at 68°F (20°C)

Flash Point for 37% Solution: 122°F (50°C), closed cup (15% methyl alcohol); 182°F (83.3°C), closed cup (alcohol free).

Autoignition Temperature: Approx 806°F (430°C)

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Corrosive to steel, copper, and copper alloys

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with strong oxidizers; strong alkalies; phenols; urea; perchloric acid; aniline; ammonia; tannin; iron preparations; gelatin; bisulfites; salts of copper, iron, and silver; hydrogen peroxide; iodine; potassium permanganate; caustics; isocyanates; anhydrides; oxides; and inorganic acids.

IDENTIFICATION

Shipping Names: Formaldehyde, solutions flammable (USDOT & IMO).

Synonyms and Tradenames: Methanal; formalin; oxomethane; methylene oxide; methylaldehyde; formic aldehyde; oxymethylene; fannoform; formalith; fyde; ivalon; lysoform; moricid; paraform; superlysoform.

Chemical Formula: HCHO

Constituent Components(% each): 30-50% W formaldehyde and 0-15% W methyl alcohol in water. Formalin is a 37% solution of formaldehyde.

UN/NA Designation: UN1198; UN2209 (flash point above 141°F., (61°C.))

IMO Designation: 3.3, flammable liquid; 9, misc. dangerous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless or cloudy

Odor Characteristics: Pungent, irritating, like hay or straw odors

Common Uses: Mfg. fungicide, germicide, disinfectants, embalming fluids, artificial silk and textiles, latex, synthetic resins, dyes, inks, mirrors, explosives, pesticides, drugs, and other chemicals; also used in paper, photographic, furniture, and tanning industries.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

FORMALDEHYDE SOLUTION

Class 3 (Flammable Liquid) or
Combustible Liquid or
Class 9 (Miscellaneous Hazardous

See "UN/NA Designation" for
other ID numbers

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1 ppm

Unusual Hazards: Combustible liquid. Suspected of being a human carcinogen. Some people may develop an allergy to formaldehyde.

Short Term Exposure Limits(STEL): 2 ppm for 15 minutes has been proposed (ACGIH).

Time Weighted Average(TLV-TWA): 2 ppm absolute ceiling limit; 1 ppm 8-hr TWA has been proposed (ACGIH).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of high gas concentrations in air as may occur in local and immediately downwind areas. Direct contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin with formaldehyde solution may be very irritating and may cause inflammation and sensitization. Eye contact may result in severe injury and corneal damage.

Hazards of Inhalation: Formaldehyde gas is very irritating to the eyes and respiratory tract. High concentrations in air may cause coughing, difficulty in breathing, pulmonary edema, pneumonitis, and possibly death. Discomfort is quite pronounced after 10-30 minutes exposure to only 4-5 ppm in air.

Hazards of Ingestion: Ingestion may cause severe irritation of the gastrointestinal tract, violent vomiting, diarrhea, severe stomach pains, dizziness, loss of consciousness, general collapse, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 7%

Upper Flammable Limit: 73%

Behavior in Fire: Combustible liquid. Will burn but difficult to ignite unless heated. There is some limited possibility that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include unburned formaldehyde and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosions may result if vapors of warm or hot liquid are ignited in a confined area. There is some limited possibility that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash- proof safety goggles, and other impervious and resistant clothing. Compatible materials include butyl rubber, natural rubber, neoprene, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, chlorinated polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, and nitrile-butadiene rubber.

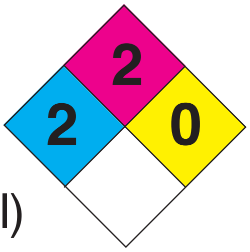
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (50 ppm or less) or an organic vapor cartridge respirator with a full face piece (50 ppm or less) within the use limitations of these devices.

2209

See "UN/NA Designation" for other ID numbers

FORMALDEHYDE SOLUTION

Class 3 (Flammable Liquid) or
Combustible Liquid or
Class 9 (Miscellaneous Hazardous Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, dry chemical, carbon dioxide, water spray. Water may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Formaldehyde spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION ... Formaldehyde may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled in cold weather.

CONSEQUENCE

Hazardous levels of formaldehyde in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

FORMALDEHYDE SOLUTION
Class 3 (Flammable Liquid) or Combustible Liquid or Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to formaldehyde vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of formaldehyde from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid formaldehyde may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of formaldehyde vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Formaldehyde may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained formaldehyde may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

FORMALDEHYDE SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid or Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

FORMALDEHYDE SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid or Class 9 (Miscellaneous Hazardous Material)

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause over flow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Carbon may not be highly effective.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 2000

FORMIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Formic acid is a colorless liquid with a pungent, penetrating odor. It is used mainly as a chemical intermediate and is completely soluble in water. The flash point of 122ºF indicates the product must be heated before ignition may occur. It has a low pH and is therefore strongly acidic, values reported range from below 1 to 2.2. Formic acid is reactive with a wide range of materials, see below, but reacts violently with furfuryl alcohol, hydrogen peroxide, hydrated thallium nitrate and permanganates. Contact with concentrated sulfuric acid results in the formation of toxic and flammable carbon monoxide gas. Accumulations of vapor in confined spaces such as sewers or buildings may explode if ignited. Vapors are heavier than air and may travel some distance to a source of ignition and flash back at any temperature above the flash point. There is some potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration especially if the stored product has decomposed. Formic acid, particularly at 98% will decompose slowly during storage liberating carbon monoxide which can rupture sealed containers. Certain salts and mineral acids will catalyze the reaction and temperature will increase the rate of decomposition. The product weighs approximately 10.2 pounds per gallon.

Formic acid does not react with water. It is generally stable in normal transportation but slowly decomposes during storage. Combustion may produce carbon monoxide and carbon dioxide; formaldehyde may be formed at temperatures greater than 572-752ºF. Toxicity hazards of the product are considerable by all routes of exposure and primarily derive from the highly irritating nature of the substance.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Complete
Solubility in Other Chemicals: Soluble in alcohol and ether.
Specific Gravity (Liquid): 1.22
Vapor Density: 1.6
Boiling Point: 224.6ºF (107ºC)
Melting Point: See freezing point
Freezing Point: 10.4ºF (-12ºC) (25% solution)
Molecular Weight: 46
Heat of Combustion: 63 kcal/mol
Evaporation Rate (butyl acetate=1): 2.1
Vapor Pressure: 35 mmHg
Flash Point: 122ºF (50ºC) closed cup
Autoignition Temperature: 1112ºF (600ºC)
Burning Rate: Unavailable
Flammable Limits: 18% (LEL) - 57% (UEL)
pH: 2.2 (85% solution) others sources report <1
Stability: Stable under ordinary conditions of use and storage.
Polymerization Potential: Will not occur.
Corrosiveness: Corrosive to metals.
Reactivity with Water: No reaction
Reactivity and Incompatibility: Reacts violently with furfuryl alcohol, hydrogen peroxide, hydrated thallium nitrate, permanganates. Contact with concentrated sulfuric acid results in the formation of toxic and flammable carbon monoxide gas. Avoid strong oxidizing agents, strong bases and finely powdered metals. Protect from moisture.

IDENTIFICATION

Shipping Name(s):Formic acid (USDOT & IMO)
Synonyms and Tradenames: Hydrogen carboxylic acid; Methanoic acid; Aminic acid; Formylic acid.
CAS Registry No.: 64-18-6
Chemical Formula: HCOOH
Constituent Components (% each): Most sources report somewhere between 85 - 95%.
UN/NA Designation: UN1779
IMO Designation: 8, Corrosives
RTECS Number: LQ4900000
NFPA 704 Hazard Rating: 3(Health): 2(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Fuming liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent, penetrating odor.
Reportable Quantity: See appendix I.
Common Uses: Chemical intermediate; textile dyeing; acidifying agent; cotton finishing; leather processing; rubber making; catalyst in hydrocarbon-formaldeyde resins; controlling particle size and thickness of electroplating in electroplating industry; antiseptic in wine and beer brewing; preservative in animal feed.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

FORMIC ACID

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.024 ppm - 5 ppm (Reports vary)

Unusual Hazards: Formic acid, particularly at 98% will decompose slowly during storage liberating carbon monoxide which can rupture sealed container. Reacts explosively with oxidizing agents.

Short Term Exposure Limit (STEL): 12 ppm (19 mg/m^3); 10 ppm (16 mg/m^3) (ACGIH)

Time Weighted Average (TLV-TWA): 5 ppm (8 mg/m^3)

Ceiling (C) Limit: Unavailable

IDLH: 30 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and downwind and from direct physical contact. Ingestion is also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid may cause severe irritation or burns and possibly result in absorption of toxic amounts of this product through the skin if the exposure is excessive. Even high concentrations of vapors in air may cause a burning skin irritation. Contact of the liquid with eyes has the potential to cause severe injury and burns. Eye discomfort includes irritation and tearing. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Inhalation of vapors can cause severe irritation of nose, throat, and upper respiratory tract. Inhalation of higher concentrations may cause central nervous system effects and lung damage.

Hazards of Ingestion: Ingestion may cause serious burns and corrosion of the mouth, throat, and esophagus, with immediate pain and difficult swallowing. Other symptoms of abdominal pain, nausea, diarrhea and vomiting can occur, leading to shortness of breath and death.

FIRE HAZARDS

Lower Flammable Limit: 18%

Upper Flammable Limit: 57%

Behavior in Fire: Exposure of containers to fire or heat may result in accelerated decomposition of product and possible container rupture. Vapors are heavier than air and may travel some distance to a source of ignition and flash back.

Hazardous Combustion Products: Combustion may produce carbon monoxide and carbon dioxide; formaldehyde may be formed at temperatures greater than 572-752ºF. Formic acid, particularly at 98% will decompose slowly during storage liberating carbon monoxide which can rupture sealed containers. Certain salts and mineral acids will catalyze the reaction and temperature will increase the rate of decomposition.

EXPLOSION HAZARDS

Explosive Potential: Reacts explosively with oxidizing agents.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

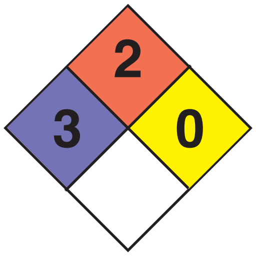
Protective Clothing Required: Equipment should prevent any possibility of skin contact and eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas tight safety goggles, and other impervious and resistant clothing. Saranex® and butyl rubber are reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases according to some authorities to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices.

1779

FORMIC ACID

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues, excessive tears in the eyes, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, halon, alcohol resistant foam. Do not use water jet.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

FORMIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to formic acid vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of formic acid from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere. The fact that foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Formic acid may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined liquid may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

FORMIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, lime or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

FORMIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

FUEL OIL

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Fuel oils (No. 2, 4, 5 and 6; see kerosene for fuel oil No. 1) are light brown liquids which have an odor like kerosene. Common uses are as a general purpose domestic or commercial fuel, particularly for home heating (fuel oil No.2), commercial or industrial heating (fuel oil No.4), and for furnaces and boilers of utility power plants, ships, locomotives, metallurgical operations and industrial power plants (fuel oil No.5). They are essentially insoluble in water and lighter, so may be expected to form a floating oil slick. Their minimum flash point ranging from about 126°F to 156°F indicates that some degree of preheating is necessary before the product can be ignited easily. Accumulations of vapor from heated liquid in confined spaces may result in explosions if ignited. There is a limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The products weigh approximately 7.3 to 7.8 pounds per gallon.

Fuel oils do not react with water or many other common materials and are stable in normal transportation. They are relatively noncorrosive substances and are primarily incompatible with strong oxidizing materials that may cause its ignition. Toxicity via potential routes of exposure is low to moderate. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Essentially insoluble.
Solubility in Other Chemicals: Soluble in other hydrocarbons.
Specific Gravity (Liquid): 0.87 - 1.05
Vapor Density: 4.7 - 8
Boiling Point: 214 - 1092ºF (101 - 589ºC)
Melting Point: See freezing point.
Freezing Point: -20 to 0ºF (-29 to -18ºC)
Molecular Weight: Mixture
Heat of Combustion: -9,700 to -10,800 cal/g
Evaporation Rate (butyl acetate=1): Very slow
Vapor Pressure: 1 - 2 mmHg (0.04psia) at 68ºF (20ºC)
Flash Point: 126 - 336°F (52 - 169ºC)
Autoignition Temperature: 494 - 763ºF (257 - 407°C)
Burning Rate: 4 mm/minute
Flammable Limits: 0.6% (LEL) - 20% (UEL)
Stability: Under normal conditions, the material is stable. Avoid sources of ignition such as flames, hot surfaces, sparks, and electrical equipment.
Polymerization Potential: Material is not known to polymerize.
pH: Essentially neutral.
Corrosiveness: Noncorrosive
Reactivity with Water: No reaction
Reactivity and Incompatibility: Avoid contact with strong oxidizers such as chlorine, fluorine, nitrogen tetraoxide, concentrated oxygen, and sodium hypochlorite or other hypochlorites.

IDENTIFICATION

Shipping Name(s): Fuel oil (USDOT) Diesel fuel or Kerosene (IMO)
Synonyms and Tradenames: Fuel oil no. 2; Fuel oil no. 4; Fuel oil no. 5; Fuel oil no. 6; Home heating oil; Diesel oil; Residual fuel oil no.4; Residual fuel oil no.5; Cat cracker feedstock; NSFO; Navy special fuel; Heavy residual fuel; Middle distillate; and Bunker C.
CAS Registry No.: 68476-30-2 (fuel oil no.2); 68476-31-3 (fuel oil no.4); 68476-33-5 (fuel oil no.6)
Chemical Formula: Mixture of Petroleum Hydrocarbons
Constituent Components (% each): Complex mixture.
UN/NA Designation: NA1993 (Fuel oil); UN1202 (Diesel fuel); UN1223 (Kerosene)
IMO Designation: 3.3 Flammable liquids
RTECS Number: NH1000314 (fuel oil no.2); FO1008628 (fuel oil no. 6)
NFPA 704 Hazard Rating: 1(Health): 2(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Reports vary; some reported to be clear, yellow, brown or black. Some sources report that they might be dyed purple or red for taxation purposes.
Odor Characteristics: Like kerosene or fuel oil.
Reportable Quantity: See appendix I.
Common Uses: General-purpose fuel for domestic, commercial, industrial burners, power plants, ships, locomotives, and metallurgical operations.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

FUEL OIL

Class 3 (Flammable Liquid) or Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.11 ppm

Unusual Hazards: None

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable but kerosene is listed as 100 mg/m^3

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, fire, and sparks, contact with incompatible materials, runoff to sewers or water bodies, inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Health hazards are generally low unless the product is ingested in significant quantities. Nevertheless, all major exposures should be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with fuel oils may cause drying and cracking of the skin due to the defatting action of these products, as well as the possibility of blisters and allergic reactions. Contact with the eyes results in mild or negligible irritation in most cases. Direct contact may cause irritation, redness, tearing and blurred vision.

Hazards of Inhalation: Prolonged exposure to high vapor concentrations in air may cause headache, drowsiness, irritation of the eyes and nose, and lung irritation. Such concentrations are generally unlikely outdoors, however, except in the immediate vicinity of the spilled product. Other symptoms may include fatigue, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death, depending on the concentration and duration of the exposure.

Hazards of Ingestion: Ingestion may cause irritation of the gastrointestinal tract, nausea, vomiting, cramping, and possible central nervous system depression with symptoms ranging from headache to anesthesia, coma, and death. Aspiration into the lungs during vomiting may result in coughing, gagging, difficult breathing, substernal distress, rapidly developing pulmonary edema, and delayed bronchopneumonia and pneumonitis with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 0.6%

Upper Flammable Limit: 20%

Behavior in Fire: Flammable liquid. Will burn but may be difficult to ignite unless warmed. There is some limited possibility that containers may rupture violently in fire. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back.

Hazardous Combustion Products: Thermal decomposition products may include carbon monoxide, carbon dioxide, oxides of sulfur and nitrogen, and other toxic gases.

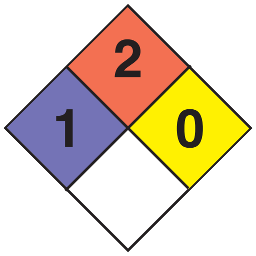
EXPLOSION HAZARDS

Explosive Potential: Forms explosive mixtures with air. Explosions may result if vapors of warm liquid are ignited in a confined area. There is some limited possibility that containers may rupture violently in fire.

1993

FUEL OIL

Class 3 (Flammable Liquid) or
Combustible Liquid



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, polyurethane, polyvinyl alcohol, Viton® , and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge may suffice.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physician: Gastric lavage may be indicated if ingested. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficulty in breathing, as adverse effects of aspiration into the lungs may be delayed for up to 48 hours.

FIRE RESPONSE

Extinguishing Agents: Foam, dry chemical, carbon dioxide, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of fuel oil may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment.

FUEL OIL

Class 3 (Flammable Liquid) or Combustible Liquid

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of fuel oil in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to fuel oil vapors or fumes may accelerate their dispersal in the atmosphere and will accumulate in low lying areas.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

FOAM . . . Foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications and monitor the area until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

FUEL OIL
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

FUEL OIL

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating fuel oil.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with fuel oil may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

January 1989

FURAN
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Furan is a highly volatile and usually colorless flammable liquid with an odor that resembles ether and a boiling point of 88.3 – 88.5°F. It is used as a solvent and for making a variety of other chemicals. Slightly soluble in water and lighter, it may be expected to form a floating surface slick that simultaneously evaporates and dissolves. Its flash point of –32°F indicates it can be easily ignited under all ambient temperature conditions. Vapors of furan are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.8 pounds per gallon.

Furan does not react with water and is generally considered stable in normal transportation. It turns to a solid resin upon evaporation or in contact with mineral acids and may turn brown upon standing when not containing a small amount of water. The product is usually shipped containing a stabilizer to prevent formation of unstable (explosive) peroxides upon exposure to air and is incompatible with oxidizing agents that may cause its ignition and with acids. Toxicity of the product ranges from low to moderate depending upon the route of exposure. Products of combustion are not well defined and may include toxic constituents.

Downwind evacuation should be considered if furan is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 1% wt at 77°F (25°C)
Solubility in Other Chemicals: Soluble in alcohol, ether, acetone, and benzene.
Specific Gravity (Liquid): 0.937 at 68°F (20°C)
Boiling Point: 88.3 – 88.5°F (31.3 – 31.4°C) at 1 atm.
Melting Point: –122.1°F (–85.6°C)
Freezing Point: See melting point
Molecular Weight: 68.07
Heat of Combustion: –7347 cal/g
Vapor Pressure: 493 mm Hg (9.53 psia) at 68°F (20°C)
Flash Point: – 32°F (– 35.6°C), closed cup
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Stable in normal transportation when stabilized. Resinifies upon evaporation or in contact with mineral acids. If unstabilized, very slowly forms unstable (explosive) peroxides upon exposure to air.
Corrosiveness: Data unavailable. Unlikely to be corrosive to metals. Likely to attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Incompatible with oxidizing agents. Contact with acids causes violent exothermic reaction.

IDENTIFICATION

Shipping Names: Furan (USDOT and IMO)
Synonyms and Tradenames: Furfuran; oxole; tetrole; divinylene oxide; oxacyclopentadiene
Chemical Formula: -CHCHCHCHO-
Constituent Components (% each): 99% or more pure. Usually stabilized with butylatated hydroxytoluene (BHT) to inhibit formation of peroxides.
49 STCC: 49 091 75
UN/NA Designation: UN2389
IMO Designation: 3.1, flammable liquid
Physical State As Shipped: Liquid
Physical State As Released: Liquid or gas (boils at 88.3 –88.5°F)
Color of the Shipped Material: Colorless liquid; turns brown on standing. Color change retarded by small amount of water.
Odor Characteristics: Like ether
Common Uses: Organic synthesis; solvent for resins and in formation of lacquers; making of pharmaceuticals, insecticides, and fine chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

FURAN
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly volatile flammable liquid. If unstabilized, it may very slowly form unstable (explosive) peroxides upon exposure to air.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable. Manufacturer suggests 1 ppm limit for chronic occupational exposures.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; prolonged exposure to air; distillation to dryness.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and downwind. Ingestion and direct physical contact are also to be avoided. Note that the toxicity of furan has not been thoroughly studied and that available information is very limited.

Hazards of Skin or Eye Contact: Limited experimentation with animals suggests that contact of the skin or eyes with liquid furan is not irritating because the chemical quickly evaporates. Nevertheless, repeated or prolonged contact may lead to absorption of toxic amounts through the skin and might be expected to cause defatting and irritation or cracking of the skin. Do not wear contact lenses when working with furan.

Hazards of Inhalation: Furan is reported to be a central nervous system depressant. Reported symptoms of acute overexposure include headache, fatigue, nausea, vomiting, unconsciousness, respiratory system paralysis, and possibly death. A concentration of 3464 ppm in air for one hour was fatal to 50% of rats in laboratory experiments. Note that a much lower widely published figure for mice is in error according to the major producer of furan.

Hazards of **Ingestion:** Furan is moderately toxic by ingestion. Symptoms are likely to resemble those of inhalation to a large extent. Known effects include congestion of the gastrointestinal tract and possible liver injury.

FIRE HAZARDS

Lower Flammable Limit (LFL): 2.3%

Upper Flammable Limit (UFL): 14.3%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable gas or vapor upon release.

Hazardous Combustion Products: Not well-defined; likely to include carbon monoxide and gaseous hydrocarbons.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Formation of unstable peroxides upon very prolonged exposure to air may lead to an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. A manufacturer of furan lists butyl rubber, natural rubber, and neoprene as compatible materials.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2389

FURAN
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific Symptoms: Headache, fatigue, nausea, or other symptoms of overexposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff: Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Electrically ground and bond all lines and equipment. Take the highly volatile, flammable, and toxic nature of furan into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Furan spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to furan vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of furan from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

FURAN
Class 3 (Flammable Liquid)

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of furan vapors into the atmosphere. The fact that alcohol foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Furan may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained furan may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCES

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment in hot weather.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, activated carbon, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accummulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines. (Note: Most furan will vaporize rapidly in warm weather.)

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable gases or vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store containinated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

FURAN
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Most furan will rapidly evaporate from water surface in warm weather while some amount dissolves from the floating slick that will form. In cold weather, the rate of exporation will be reduced and time may permit application of oil spill type containment and/or cleanup techniques if the flammability hazards of furan can be safely controlled. The first three techniques below apply to the dissolved portion. The others that follow are generally applicable to hydrocarbons that float on water.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as need until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Mineral acids promote resinification of furan. Solids that form may require removal from the water body.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air striping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

FURAN
Class 3 (Flammable Liquid)

TECHNIQUES

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of bypass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating furan.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with furan may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

March 1995

FURFURYL ALCOHOL

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Furfuryl alcohol is a colorless or pale yellow or amber liquid that may slowly become brown to dark red or black upon exposure to light and air and has a mildly irritating odor. It is used as a solvent, as a liquid propellant, for treating sand in foundries and oil wells, and for making furan resins, polymers, and other products. It is fully soluble in water and slightly heavier. Its flash point of 149°F indicates that it must be moderately heated before ignition may occur easily. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 9.4 pounds per gallon.

Furfuryl alcohol does not react with water or many other common materials. It will darken and form water-insoluble material during transport if exposed to air or acids, particularly when hot. Reactions with cyanoacetic acid, formic acid, and strong mineral or organic acids may be explosive and may involve violent self-polymerization. The alcohol dissolves lacquers, varnishes, or epoxy resins. Toxicity varies with route of exposure. Products of combustion are not well-defined and may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Fully soluble

Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform and most organic solvents with the exception of petroleum hydrocarbons and most oils.

Specific Gravity (Liquid): 1.129 at 68°F (20°C)

Boiling Point: 338°F (170°C) at 1 atm.

Melting Point: -20.2°F (-29°C) or -25.9°F (-14.6°C) depending on form.

Freezing Point: 5°F (-15°C)

Molecular Weight: 98.1

Heat of Combustion: -6200 cal/g

Vapor Pressure: 1 mm Hg (0.019 psia) at 89.2°F (31.8°C)

Flash Point: 149°F (65°C), closed cup; 167°F (75°C), open cup.

Autoignition Temperature: min. 736°F (391°C); max. 915°F (490°C); reported values vary.

Burning Rate: 2.3 mm/minute

Stability: Stable, but may polymerize under conditions described above.

Corrosiveness: Dissolves lacquers, varnishes, or epoxy resins. Can be stored in ordinary steel tanks (up to 6 months) and in tanks lined with baked phenolic coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with cyanoacetic acid, formic acid, strong mineral acids, nitric acid, hydrogen peroxide or nitrogen tetroxide, strong organic acids, Lewis acids, and acyl halides.

IDENTIFICATION

Shipping Names: Furfuryl alcohol (USDOT & IMO).

Synonyms and Tradenames: 2-hydroxymethyl furan; furfural alcohol; furfuralcohol; furyl alcohol; 2-furancarbinol; 2-furanmethanol; alpha- or 2-furylcarbinol; FA.

Chemical Formula: $C_4H_3OCH_2OH$

Constituent Components(% each): Rather pure with small amounts of water and furfural.

UN/NA Designation: UN2874

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless, pale yellow or amber but may become brown to dark red or black in light and air.

Odor Characteristics: Mildly irritating.

Common Uses: Wetting agent, penetrant, and solvent; liquid propellant; used in foundry cores and in oil well treating; mfg. Of furan resins, polymers, sealants, cements, and tetrahydrofurfuryl alcohol; flavoring.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

FURFURYL ALCOHOL

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 8 ppm

Unusual Hazards: Violent polymerization may be initiated by mineral acids or organic acids. Otherwise, a combustible alcohol of relatively low volatility and moderate toxic hazard.

Short Term Exposure Limits(STEL): (Skin) 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 10 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of concentrated vapors in air, but the hazard is limited due to the relatively low volatility of the substance. Eye contact with the liquid and ingestion should clearly be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with liquid furfuryl alcohol may result in moderate irritation, defatting, dermatitis, and absorption via the skin. Contact with the eyes may cause severe inflammation and possible corneal opacity.

Hazards of Inhalation: Vapors may cause eye, nasal, and respiratory tract irritation. High concentrations in air may result in narcosis with symptoms including headache and nausea. Exposure to 233 ppm in air for 4 hours is lethal to 50% of laboratory rats. A level of 700 ppm was lethal to some mice in 10 minutes.

Hazards of Ingestion: Ingestion of furfuryl alcohol may cause gastrointestinal irritation, nausea, headache, diarrhea, and vomiting. Less than one-third ounce may be fatal based on animal studies.

FIRE HAZARDS

Lower Flammable Limit: 1.8% at 162°F (72.5°C)

Upper Flammable Limit: 16.3% at 252°F (122°C)

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite. There is some limited potential that containers may rupture violently in fire.

Hazardous combustion products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: There is some limited potential that containers may rupture violently in fire. Violent polymerization may occur in the presence of organic or mineral acids. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Explosion may result if vapors of heated liquid are ignited in a confined area.

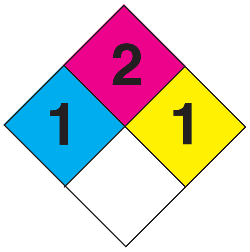
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

2874

FURFURYL ALCOHOL
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, skin, or gastrointestinal tract.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water spray for dilution to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. See the General Information section for the reactivity hazards of furfuryl alcohol.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION ... Furfuryl alcohol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of furfuryl alcohol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to furfuryl alcohol vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of furfuryl alcohol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

FURFURYL ALCOHOL
Division 6.1 (Poisonous Material)

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid furfuryl alcohol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM ... Alcohol foam applied to the surface of liquid pools may slow the release of furfuryl alcohol vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent to liquid furfuryl alcohol may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Furfuryl alcohol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained furfuryl alcohol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

FURFURYL ALCOHOL
Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other incompatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAl ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2006

GASOLINE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Gasoline is a volatile colorless to amber or pale brown liquid hydrocarbon that may also be dyed various colors. It is most commonly used as fuel but also has uses as a diluent and solvent in industry. Essentially insoluble in water and lighter, gasoline will float to form a surface slick. Its flash point may be as low as –50°F and indicates that the product is easily ignited under most ambient temperature conditions. Vapors of gasoline are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.9–6.1 pounds per gallon.

The chemical and physical properties, as well as the composition, of gasoline can vary greatly depending on the specific product and the origin of the crude oil. Due to differences in composition, there may be components that are themselves, hazardous and may require the use of additional guides. Gasoline does not react with water or many other common materials and is stable in normal transportation. It is a relatively noncorrosive substance and is primarily incompatible with oxidizing materials that may cause its ignition. Toxicity of the product ranges from low to high depending on the route of exposure. Products of combustion may include toxic products from lead compounds and other additives, as well as other toxic constituents.

If gasoline is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration. (Note: Data given below are for automotive gasoline but are also mostly applicable to other types not containing alcohols.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 100–600 ppm

Solubility in Other Chemicals: Soluble in ether, chloroform, ethanol and other hydrocarbons.

Specific Gravity (Liquid): 0.73 at 68°F (20°C)

Vapor Density: 2.5 – 4.0

Boiling Point: 140 – 390°F (60 – 199°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: –131 to –140°F (–90.6 to –95.6°C)

Molecular Weight: Mixture, 72 – 142 (est.)

Heat of Combustion: –10,400 cal/g

Evaporation Rate (butyl acetate=1): One source reports 4–10, others report >10

Vapor Pressure: 190 mmHg (3.67 psia) at 68°F (20°C), some mixtures may be as low as 38 mmHg

Flash Point: –38 to –50°F (–38.9 to –45.6°C), cc

Autoignition Temperature: 495 – 853°F (257 – 456°C), varies with grade.

Burning Rate: 4 mm/minute

Flammable (Explosive) Limits: 0.6–1.4% (LEL) – 7.1–7.6% (UEL)

Stability: Stable

Polymerization Potential: Will not occur

pH: Not applicable

Corrosiveness: Noncorrosive, but may attack some forms of plastics, rubbers or coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with oxidizing materials, such as peroxides, nitric acid and perchlorates.

IDENTIFICATION

Shipping Names: Gasoline, Petrol, or Motor spirit (USDOT & IMO)

Synonyms and Tradenames: Light gasoline; Natural gasoline; Petrol; Motor spirit; Motor fuel; Casing head gasoline; Blended gasoline; Automotive or aviation gasoline; Benzin

CAS Registry No.: 8006-61-9; 86290-81-5 (refinery blend motor gasoline)

Chemical Formula: C_5–C_{10} hydrocarbon mixture

Constituent Components (% each): Complex hydrocarbon mixture; may contain small amounts of lead compounds, paraffins, cycloparaffins, benzene, naphthalene, ethanol, aromatics and other additives.

UN/NA Designation: UN1203

IMO Designation: 3, flammable liquids

RTECS Number: LX3300000

NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Instability)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless to amber or brown; may be dyed other colors

Odor Characteristics: Like typical gasoline

Common Uses: Solvent or diluent; finishing agent for artificial leather; motor fuel; portable stove and lantern fuel.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

GASOLINE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reports vary as low as 0.025; others report 0.12 – 0.15 ppm (recognition) 0.06 – 0.08 ppm (threshold)

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back or persist in low areas. May contain lead compounds or other toxic additives. Flowing product may be ignited by self-generated static electricity.

Short Term Exposure Limits (STEL): Potential occupational carcinogen (NIOSH); 500 ppm (ACGIH) Note: Gasoline is a mixture of compounds, some of which are very toxic and may have a lower exposure limits.

Time Weighted Average (TLV-TWA): Potential occupational carcinogen (NIOSH); 300 ppm (ACGIH)

Ceiling (C) Limit: Potential occupational carcinogen (NIOSH)

IDLH: Potential occupational carcinogen (NIOSH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard to public is from prolonged exposure to the significant vapor concentrations that may be present in air after major spills. Ingestion and physical contact should also be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with gasoline may cause drying and cracking of the skin due to the defatting action of the product (and possible blistering or lesion formation). Certain individuals may develop hypersensitivity. Contact with the eyes may result in smarting and pain, but only slight and temporary injury.

Hazards of Inhalation: Vapors act as a central nervous system depressant and may be irritating. Low concentrations in air may cause flushing of the face, staggering gait, headache, dizziness, slurred speech and mental confusion. High levels may cause convulsions, unconsciousness, coma, pulmonary edema, and possibly death from respiratory failure or asphyxiation. There may also be damage to the pancreas, liver, kidneys and spleen.

Hazards of Ingestion: Ingestion may result in irritation of the mouth, throat and stomach; irregular heartbeat; stimulation and later depression of the central nervous system (see above). Aspiration into the lungs during vomiting may result in severe lung irritation with coughing, gagging, difficult breathing, substernal distress, rapidly developing pulmonary edema, and possibly delayed bronchopneumonia and pneumonitis with severe consequences.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 0.6–1.4%

Upper Flammable (Explosive) Limit: 7.1–7.6%

Behavior in Fire: Extremely flammable liquid and will readily ignite at room temperature. Will generate large quantities of flammable or explosive vapors upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Product may float on water and may travel to distant locations or spread fire.

Hazardous Decomposition Products: Not well-defined, may include toxic products from additives like lead compounds as well as other toxic constituents, hydrocarbons, aromatics, oxides of nitrogen and phenols. One source reports that contact with nitric and sulfuric acid may form nitrocresols that can decompose violently.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

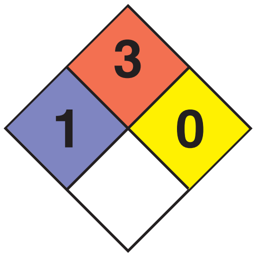
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: **For emergency response situations, structural firefighting clothing for firefighting or fire retardant coveralls, such as Nomex or PBI are required.** Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include nitrite rubber, nitrile latex gloves, chlorinated polyethylene, polyurethane, polyvinyl alcohol, Viton® and nitrite-butadiene rubber. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 3 (mixed gasoline); Tychem® (BR; LV; Responder®; Responder® CSM; TK; Reflector®) (leaded gasoline); Nitrile; Viton®; Barricade®; Nitri Solve 727® gloves; Viton 892® gloves; Neop. N5 or N8® gloves; Viton 890® gloves. The following materials are reported to have a greater than 4 hour breakthrough time: polyvinyl alcohol gloves; 4H® and Silver Shield® brand gloves; Responder® suits. The following materials are **not** recommended for use: neoprene rubber, latex, natural rubber or butyl rubber.

1203

GASOLINE

Class 3 (Flammable Liquid)



Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations: any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Regular foam, carbon dioxide, dry chemical, water spray. Water may be ineffective as it may not cool gasoline below its flash point.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Gasoline will float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases. Note that gasoline has a flash point of –38 to –50°F.

SPILL RESPONSES

General Information: Gasoline is a highly flammable and volatile liquid that may cause environmental contamination. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of gasoline may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that gasoline is a highly volatile and highly flammable substance and will float on top of water.

GASOLINE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Gasoline may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed.

CONSEQUENCE

Hazardous levels of gasoline in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to gasoline vapors or fumes may accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Water runoff may contain a small amount (if any) of gasoline from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of gasoline vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Gasoline may be contained by building dikes or barriers using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained gasoline may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

GASOLINE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

GASOLINE

Class 3 (Flammable Liquid)

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present, or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating gasoline.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with gasoline may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

January 1989

HELIUM
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Helium is a colorless, odorless, nonflammable and nontoxic element of nature that is handled as a compressed gas under high pressure or as a refrigerated cryogenic liquid at extremely low temperatures. It has a variety of uses in research, for filling balloons and blimps (being the gas normally used to fill floating balloons), and in gas supplies for divers, space vehicles, luminous signs, welding, and chromatography. Due to its slight solubility in water and boiling point of –452.1°F, spills of liquid on land or water may quickly generate relatively large amounts of gas that may appear white at first due to condensation of water vapor in the air. Initially, the gas may be much heavier than air, but it becomes substantially lighter than air as it warms. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The refrigerated liquid weighs approximately 1.23 pounds per gallon near its boiling point temperature.

Due to the fact that the compressed gas is shipped at temperatures far in excess of its very low critical temperature, the pressure within containers of compressed gas is a function of the temperature of the container and the amount of helium it contains (such that the term "vapor pressure" no longer has meaning). These pressures can vary, but are typically on the order of 170 – 140 atmospheres (2500 – 3500 psig) at room temperature within gas cylinders.

Helium is an inert substance that does not react with other materials and is stable in transportation. Although it is completely nontoxic, the large volumes of gas that may be generated in a major accident may cause suffocation by displacing oxygen in the air. 'the extremely low temperatures that may occur under certain conditions of release (primarily but not exclusively from discharges of liquid) may cause tissue damage and burns due to frostbite.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very slightly soluble; 0.97 ml (gas)/ 100 ml water at 32°F (0°C); 0.861% by volume at 68°F (20°C).
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 0.147 at –455.8°F (–271°C)
Boiling Point: –452.1°F (–268.9°C) at 1 atm.
Melting Point: Cannot be frozen at ordinary pressure
Freezing Point: –457.6°F (–272°C) at 25.2 atm
Molecular Weight: 4.0
Heat of Combustion: Not flammable
Vapor Pressure: See General Information section above.
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: Noncorrosive; requires no special materials of construction so long as temperatures and pressures are tolerated.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: None; not known to combine with any other element; considered inert.

IDENTIFICATION

Shipping Names: Helium (USDOT and IMO); helium, refrigerated liquid (USDOT and IMO); helium, compressed (USDOT).
Synonyms and Tradenames: None, helium is one of the natural elements.
Chemical Formula: He_2
Constituent Components (% each): More than 99.99% pure
49 STCC: 49 045 40 (helium or compressed helium); 49 045 39 (refrigerated or compressed helium).
UN/NA Designation: UN1046 (helium, compressed helium); UN1963 (refrigerated, cryogenic liquid).
IMO Designation: 2.2, nonflammable gas
Physical State As Shipped: Compressed or liquefied (refrigerated) gas
Physical State As Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless
Common Uses: Rocket research; nucleonics; lasers; filling balloons and blimps; producing low temperatures or inert atmospheres; leak detection; diving and space vehicle breathing equipment; luminous signs; welding; chromatography; etc.

HELIUM
Division 2.2 (Nonflammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor **Concentration:** Odorless

Unusual Hazards: Large volumes of nontoxic and nonflammable gas generated upon release may cause suffocation via displacement of oxygen in air at high concentrations. Extreme cold of liquid or vapors may cause tissue damage or burns due to frostbite. Temperatures involved may be low enough to liquefy air on the surface of cold equipment.

Short Term Exposure Limits (STEL): Unavailable; see below

Time Weighted Average (TLV-TWA): Unavailable; listed as simple asphyxiant.

Conditions to Avoid: Entry into any area in which oxygen levels may be reduced unless a self-contained breathing apparatus is worn. Contact with cold liquid, gas, or containment equipment. Use of equipment not suitable for the temperatures and pressures that may be encountered.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the high gas concentrations that may be present in air in the immediate spill area. Contact should be avoided with cold liquid, gas, or containment equipment to prevent tissue damage and burns due to frostbite.

Hazards of **Skin** ***or Eye Contact:*** Contact with liquid helium or cold helium gas may cause extensive tissue damage or burns due to the extremely cold temperatures involved. Blistering and deep tissue freezing may occur from excessive contact.

Hazards of Inhalation: High concentrations of helium gas in air may cause suffocation by diluting the concentration of oxygen in air below levels necessary to support life. Lack of oxygen may produce dizziness, nausea, errors in judgment, fatigue, accelerated pulse, gasping, confusion, vomiting, loss of consciousness and death, possibly in seconds and without warning.

Hazards of Ingestion: Ingestion of liquid helium is highly unlikely.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable compressed gas or refrigerated liquid. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of gas upon release.

Hazardous Combustion Products: Not flammable; will not decompose.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Not flammable but containers may rupture violently in fire due to overpressurization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with excessively cold liquid helium, gas, or containment equipment. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Note that respirators will not function in oxygen depleted environments and may lead to suffocation.

FIRST AID

Nonspecific Symptoms: Symptoms of oxygen deficiency or frostbite.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration and get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of water. Get medical attention immediately. Do not use hot water or rub frostbitten areas.

1046

HELIUM
Division 2.2 (Nonflammable Gas)

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid bodily contact with cold liquid or gas. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential due to overpressurization. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers Cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent entrapment of liquid in dosed systems, Use oxygen monitoring equipment to test for oxygen deficient atmospheres where necessary. Vent helium to atmosphere slowly in well ventilated outdoor location if this method of disposal is selected. Note that liquid helium in exposed piping can actually cause air to condense and liquefy. The nitrogen in this liquid air can evaporate more rapidly, leaving behind an oxygen enriched liquid. Consequently, any insulating materials used should be compatible with oxygen. Only metals and materials compatible with extremely low temperatures and/or high pressures should be used, thus excluding use of carbon steel and other metals that become brittle when used at low temperatures.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Helium discharges may not generate hazardous airborne contaminant concentrations over significant distances in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the product is removed or depleted, particularly if less than large amounts have been released in outdoor locations.

CONSEQUENCE

Hazardous levels of helium in air may be found in the local spill area and immediately downwind.

MITIGATION

Restrict access to the local spill area and areas immediately downwind of unprotected personnel until flow is stopped or the container empties. Check for oxygen levels in air.

TECHNIQUE

EVACUATION . . . Where necessary due to the possibility of massive releases in populated areas, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HELIUM
Division 2.2 (Nonflammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid helium, where necessary due to vulnerable surroundings, may be contained by building dikes or barriers using soil, sand or other materials. Note that any spilled liquid will boil vigorously at first and continue to vaporize rapidly.

TECHNIQUE

EXCAVATION . . . Where necessary, a trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Where necessary and possible, accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks due to the high pressures and low temperatures that may be encountered.

MITIGATION

Use suitable equipment. Consider allowing liquid helium to evaporate until depleted or use a light water spray to accelerate boil-off.

WATER SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Any liquid helium contacting a water body will rapidly boil off. Traces of helium remaining in the water (if any) should be completely harmless.

January 1990

HEPTANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Heptane is a clear, colorless, and somewhat volatile liquid hydrocarbon with a mild odor similar to gasoline. It is used as a general solvent and extractant in industry, for organic synthesis and preparation of laboratory reagents, and as a standard in testing knock in gasoline engines. Practically insoluble in water and lighter, heptane will form a floating surface slick. Its flash point of 25°F for the pure liquid indicates that the product is easily ignited under most ambient temperature conditions. Vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flash back, particularly in warm weather. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.7 pounds per gallon.

Heptane does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials, however, and may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low to moderate. Products of combustion may include toxic constituents.

If heptane is leaking (not on fire), downwind evacuation should be considered on a case by case basis until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.005 g/100 g water (50 ppm) at 59°F (15°C); 3 ppm in fresh water and 10.5 ppm in salt water at 68°F (20°C).

Solubility in Other Chemicals: Soluble in alcohol, chloroform, ether, acetone, and hydrocarbons.

Specific Gravity (Liquid): 0.684 at 68°F (20°C)

Boiling Point: 209.1°F (98.4°C) at 1 atm.

Melting Point: –131°F (– 90.6°C)

Freezing Point: See melting point

Molecular Weight: 100.2

Heat of Combustion: –10,650 cal/g

Vapor Pressure: 35 – 40 mm Hg (0.677 – 0.773 psia) at 68°F (20°C); reported values vary

Flash Point: 25°F (–3.9°C), closed cup; 30°F (–1.1°C), open cup

Autoignition Temperature: 399 – 433°F (204 – 222°C)

Burning Rate: 6.8 mm/minute

Stability: Stable

Corrosiveness: Noncorrosive to metals but may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react or ignite in contact with strong oxidizing agents or materials.

IDENTIFICATION

Shipping Names: Heptane (USDOT and IMO)

Synonyms and Tradenames: n-Heptane; normal heptane; heptyl hydride; dipropylmethane; Skellysolve C; Gettysolve C

Chemical Formula: $CH_3(CH_2)_5CH_3$

Constituent Components (% each): Various grades are mostly heptane with remainder consisting of petroleum hydrocarbons such as dimethyl pentanes and cyclopentanes, methyl hexanes, toluene, cyclohexane, and others.

49 STCC**:** 49 091 90

UNINA Designation: UN1206

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Like mild gasoline

Common Uses: Standard in testing knock in gasoline engines; anesthetic; used in organic synthesis and preparation of laboratory reagents; general solvent and extractant.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HEPTANE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 200 ppm for 100% odor recognition; other reported values vary from *2* to 2000 ppm.
Unusual Hazards: Somewhat volatile flammable liquid with slightly heavier than air vapors at ambient temperatures.
Short Term Exposure Limits (STEL): 500 ppm for *15* minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 400 ppm over each 8 hours of a *40* hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS.

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided. Note that heptane may cause some degree of sensitization of the heart to epinephrine.
Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid heptane may result in drying and cracking of the skin due to the defatting action of the product and also lead to pain, redness, swelling, itching, and burning. Some amounts may be absorbed through the skin. Contact of liquid heptane with the eyes may cause slight irritation including redness and swelling of the mucous membranes. Do not wear contact lenses when working with heptane.
Hazards of Inhalation: Exposure to heptane vapors in air may cause some irritation of the eyes, nose, and/or respiratory tract in some but not all individuals. Inhalation of higher concentrations may cause narcosis and central nervous system depression with symptoms including lightheadedness, rapid breathing, dizziness, hilarity, nausea, loss of appetite, vertigo, incoordination, stupor, convulsions, tremors, unconsciousness, and possibly death in severe cases. Humans exposed to 1000 ppm for six minutes or 2000 ppm for four minutes reported slight vertigo. A level of 5000 ppm for 15 minutes produced stupor lasting 30 minutes with a prolonged aftertaste of gasoline. Mice exposed to 15,000 to 20,000 ppm for 30 to 60 minutes convulsed and died in laboratory experiments.
Hazards of **Ingestion:** Detailed information on the effects of heptane ingestion are not available but the product is expected to be of relatively low oral toxicity with symptoms resembling those of inhalation but also including gastrointestinal irritation, vomiting, and diarrhea. Aspiration into the lungs during vomiting may cause pulmonary edema, chemical pneumonia, hemorrhage, respiratory paralysis, asphyxia, and/or cardiac arrest with possibly severe consequences. Some effects may be delayed in onset.

FIRE HAZARDS

Lower Flammable Limit: 1.0 – 1.2%
Upper Flammable Limit: 6.7 – 7.0%
Behavior in Fire: Flammable liquid. May generate flammable vapors upon release. Vapors may be somewhat heavier than air and travel some distance to a source of ignition and flash back. Containers have some limited potential to rupture violently in fires.
Hazardous Combustion Products: Not well-defined; said to be acrid and to contain carbon monoxide, carbon dioxide, and various hydrocarbons which may be toxic.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. There is a limited potential that containers may rupture violently in fire.

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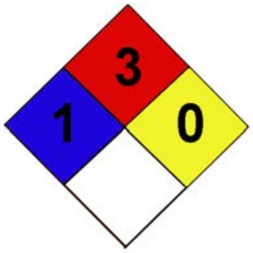
HEPTANE
Class 3 (Flammable Liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 4250 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (4250 ppm or less) or a chemical cartridge respirator with a full facepiece (850 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; symptoms of narcosis and central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to ,area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of heptane may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that heptane is a flammable liquid.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Heptane spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm or hot weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HEPTANE
Class 3 (Flammable Liquid)

TECHNIQUE

MONITOR THE SITUATION . . . Heptane may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cool or cold weather.

CONSEQUENCE

Hazardous levels of heptane in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product a$ soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to heptane vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of heptane from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination: Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of heptane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Heptane may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained heptane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

HEPTANE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, vermiculite, perlite, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal, equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Heptane spills will float on water while evaporating at a relatively slow rate and dissolving in the water at an extremely slow rate.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 – 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

HEPTANE
Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating heptane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with heptane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: This and the following potential spill responses should be considered only where critical water resources have been impacted and it is desired to remove all traces of the spilled product. Consult qualified experts for advice where necessary.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

HEXACHLOROCYCLOPENTADIENE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Hexachlorocyclopentadiene, called "HCCPD" in this Guide for short, is a yellowish, amber, or greenish yellow noncombustible substance with an odor described as pungent, harsh, and/or unpleasant. With a melting point in the range of 48.2 - 52.4°F (9 - 11.3°C), the product may be either a solid or liquid at ambient temperatures. Used to make plastics, dyes, pesticides, fungicides, pharmaceuticals and other chemical substances,

HCCPD is heavier than water and practically insoluble therein, so may be expected to sink and dissolve very slowly. It will also react slowly with water to form hydrochloric acid which corrodes many metals while producing flammable and potentially explosive hydrogen gas. HCCPD weighs about 14.3 pounds per gallon as a liquid. HCCPD is stable under normal conditions of storage, but besides its reactivity with water, is reported as incompatible with various chemicals and explosive in contact with sodium. The product is corrosive to bodily tissues, and most importantly (and despite its low vapor pressure), generates vapors which are extremely toxic to humans even at very low concentrations in air. Exposure to fire causes thermal decomposition of HCCPD and is reported to result in generation of corrosive and/or poisonous gases such as hydrogen chloride, chlorine, phosgene, carbon monoxide, and possibly other harmful substances.

Downwind evacuation or an alternative protective action must be considered based on the amount of material released, location, weather conditions, and whether or not the product is thermally decomposing in a fire or exposed to high heat if HCCPD is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, that a large amount of noncombustible but extremely toxic vapors may be released into the atmosphere if the container ruptures.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.805 ppm (805 ppb) at 77°F (25°C).

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, hexane, and certain other organic solvents.

Specific Gravity (Liquid): 1.71 at 68°F (20°C).

Boiling Point: 462°F (239°C) at 1 atm.

Melting Point: 48.2 - 52.4°F (9 - 11.3°C).

Freezing Point: See melting point.

Molecular Weight: 272.77.

Heat of Combustion: Not combustible.

Vapor Pressure: 0.08 mm Hg (0.001546 psia) at 77°F (25°C); 1 mm Hg (0.019329 psia) at 140°F (60°C).

Flash Point: Not combustible.

Autoignition Temperature: Not combustible.

Burning Rate: Not combustible.

Stability: Stable under normal conditions of storage.

Corrosiveness: Hydrochloric acid formed in slow reaction of HCCPD with water or moisture will corrode most metals, particularly iron and aluminum, with evolution of flammable and potentially explosive hydrogen gas that may accumulate in enclosed spaces. A maker of the product suggests the product be stored in nickel clad or phenolic lined containers and implies that HCCPD may react slowly with common metals even in the absence of water.

Reactivity with Water: Reacts very slowly and in a non-hazardous fashion to form hydrochloric acid and less chlorinated forms of hexachlorocyclopentadiene.

Reactivity with Other Chemicals: Available data are limited. Reported to be incompatible with strong acids, strong bases, or oxidizing agents; said to react slowly with many substances including common metals. May explode in contact with sodium. Any hydrochloric acid formed in reactions with water may be reactive with a wide variety of substances.

IDENTIFICATION

Shipping Names: Hexachlorocyclopentadiene.

Synonyms and Tradenames: 1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-; hexachloro-1,3-cyclopentadiene; 1,2,3,4,5,5-hexachloro-1,3-cyclopentadiene; HCCPD; PCL; perchlorocyclopentadiene; and various tradenames including C-56; Graphlox; and HRS 1655.

Chemical Formula: Molecular formula is C_5Cl_6; structural formula is $-(CCl)_4-CCl_2-$; the material has a five-sided ring structure.

Constituent Components (% each): Limited data available. Apparently 97% or more pure; some products may be close to 100% pure.

UN/NA Designation: UN2646.

IMO Designation: *6.1, poisonous* material.

Physical State As Shipped: Liquid or solid.

Physical State As Released: Liquid or solid; solidifies at 48.2 - 52.4°F (9 - 11.3°C).

Color of the Shipped Material: Variably described as pale yellow, yellow, amber, and greenish yellow.

Odor Characteristics: Described as pungent, harsh, and/or unpleasant.

Common Uses: Used to make resins, plastics, dyes, pesticides, fungicides, pharmaceuticals, and various other chemical substances.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

HEXACHLOROCYCLOPENTADIENE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.15 ppm; pronounced pungent odor at 0.33 ppm in air.
Unusual Hazards: Despite a low vapor pressure at normal ambient temperatures, HCCPD vapors are extremely toxic at even very low concentrations in air. Hydrochloric acid is formed when HCCPD reacts with water or moisture.
Short Term Exposure Limit (STEL): Not established
Time Weighted Average (TWA) Limit: *0.01* ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93).
Ceiling (C) Limit: Not established
Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the extremely toxic vapors of HCCPD that may present in air in the spill area and over considerable downwind distances. Direct contact and ingestion should also be strictly avoided. Of greatest concern would be situations in which the spilled product is exposed to heat which increases its vaporization rate and/or a bulk container exposed to extereme fire or excessive heat ruptures and suddenly releases large amounts of hot noncombustible liquid and extremely toxic vapors.
Hazards of Skin or Eye Contact: The vapors of HCCPD are severely irritating to the eyes and cause lacrimation. Contact of the liquid or solid product with the eyes is reported to result in burns, which indicates the possibility of permanent impairment of sight or blindness. Contact of the skin with HCCPD may result in severe irritation, blisters, burns, and/or destruction of tissue. Prolonged contact may result in harmful amounts being absorbed through the skin. Indeed, even contact of "high" concentrations of vapors with the skin is considered hazardous. Any HCCPD which contacts the skin should be removed as soon as possible. Contact lenses should not be worn when working with this chemical.
Hazards of Inhalation: Vapors or mists of HCCPD are extremely toxic to humans. Symptoms of exposure are variably reported to include severe irritation of the nose, throat and lungs, sneezing, coughing, headache, nausea, excessive salivation, chest discomfort, abdominal cramps, difficult breathing, gasping respiration, bronchitis, tremors, pulmonary hyperemia and pulmonary edema (which is likely to be delayed in onset), pneumonia, and possibly death. Autopsies have revealed degenerative and necrotic changes in the brain, heart and adrenal glands as well as necrosis of liver and kidney tubules. Ingestion of alcohol before or after an exposure may greatly aggravate injurious effects on the liver. Exposures not causing the more severe effects listed above may result in symptoms such as fatigue, respiratory tract irritation, headaches, and eye irritation that persist for weeks (and which may include excess serum proteins in the urine and elevated serum lactic dehydrogenase levels). Exposure to only 1.6 ppm in air for 4 hours was lethal to 50% of male rats in laboratory experiments. The saturated vapor concentration directly over a pool of HCCPD at 77°F (25°C) is about 105 ppm. Such concentrations can rise to about 1315 ppm at 140°F (60°C), 12,250 ppm at 220°F (104°C) and 71,600 ppm at 300°F (149°C) if HCCPD warms up when exposed to a source of heat in a spill situation.
Hazards of Ingestion: One authority lists nausea, vomiting, diarrhea, and depression (probably of the respiratory system) as symptoms of ingestion while another repeats several severe effects associated with inhalation including those involving the brain, heart, liver, adrenal glands, kidneys, and lungs. The lowest single oral dose reported as lethal to 50% of rats in laboratory experiments is 584 milligrams of HCCPD per kilogram of an animal's body weight. It is expected that consumption of alcohol before or after an exposure may greatly increase liver damage.

FIRE HAZARDS

Lower Flammable Limit: Not combustible.
Upper Flammable Limit: Not combustible.
Behavior in Fire: Some authorities warn that bulk containers of the product may explode in a fire but that probability of this in transportation appears to be quite low except possibly under extreme conditions (though small containers may rupture due to expansion of the liquid upon heating). Not combustible, exposure to heat will increase its vapor pressure and the rate at which it will generate extremely toxic vapors.
Hazardous Combustion Products: Exposure to fire or very high tempertures may cause thermal decomposition of HCCPD and generation of poisonous and/or corrosive gases such as hydrogen chloride, chlorine, carbon monoxide, and phosgene.

EXPLOSION HAZARDS

Explosiveness: See "Behavior in Fire" section above for discussion of container explosion possibility. Contact with certain other chemicals or materials may result in an explosion. Any accumulations of hydrogen gas produced by the action of hydrochloric acid on metals may explode if ignited in a confined space; see "Corrosiveness" section for further details.

2646

HEXACHLOROCYCLOPENTADIENE
Division 6.1 (Poisonous Material)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and vapor-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with "high" vapor concentrations in air or the products of thermal decomposition of HCCPD in a fire. Several authorities agree that compatible materials for HCCPD itself may include butyl rubber, nitrile rubber, polyvinyl alcohol, and Viton. Be advised that many factors affect the suitability of a material for any given application. Ensure that the specific protective clothing and devices chosen will provide adequate protection under actual conditions to be encountered.

Respiratory Protection: Whenever or wherever the concentration of HCCPD may exceed 0.01 ppm in air, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, headache, salivation, chest discomfort, abdominal cramps, difficult breathing, tremors, nausea, vomiting, diarrhea, fatigue, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Do not permit consumption of alcohol after any exposure.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if irritation or other effects persist after washing.

First Aid for Ingestion: If conscious, have victim wash out mouth with water (which should not be swallowed); then administer several glasses of water or milk. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Do not permit consumption of alcohol after any exposure.

FIRE RESPONSE

Extinguishing Materials: HCCPD is not combustible. Use agent suitable for surrounding fire but do not permit water to enter containers of HCCPD.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with "high" vapor concentrations in air or products of thermal decomposition of HCCPD is anticipated. Move container from fire area if no risk. Be alert to the warning that the container may explode and suddenly release massive amounts of HCCPD and various gases when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out but do not permit water to enter containers. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with extreme caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines as necessary. Be advised there is a possibility that discharge of a carbon dioxide fire extinguisher at the point of leakage of liquid HCCPD has the potential to solidify the product and stop the leak in some cases, at least temporarily. Other means of attempting to solidify the leaking liquid and/or reducing its vapor pressure via cooling may also work. Whether or not a "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the container and its temperature. Use professional judgment in attempting this type of response action. Take the reactivity and extremely toxic nature of HCCPD into account while planning the response.

HEXACHLOROCYCLOPENTADIENE
Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. HCCPD discharges may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to HCCPD vapors may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact the HCCPD if this is not desirable under the circumstances. Conversely, if the HCCPD is being warmed by a nearby source of high heat, the water may help keep the HCCPD cool and thereby reduce its rate of toxic vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of hydrochloric acid, HCCPD, and possibly similar hazardous substances.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible and as necessary to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of confined liquid pools or solidified liquid pools of HCCPD may slow the release of HCCPD vapors into the atmosphere.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors may increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . HCCPD is practically insoluble in water, heavier than water, and reported to react slowly with water in a non-hazardous fashion. There is an unconfirmed possibility that coverage of confined liquid pools, particularly with cold water, and using a gentle water spray, may form a layer or blanket of water over the HCCPD which reduces toxic vapor emissions.

CONSEQUENCE

Addition of water will increase the volume of contained liquids. Hydrochloric acid and possibly other hazardous substances may be formed by the slow reaction of HCCPD with water.

MITIGATION

Contain spilled liquids and neutralize and/or remove them as soon as possible and as necessary. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid HCCPD or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained liquids and spread of contamination.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible and as necessary to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

LAND SPILL *(CONTINUED)*

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product or contaminated water runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible and as necessary to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Any hydrochloric acid present may generate flammable and potentially explosive hydrogen gas within incompatible equipment. At or below the melting point temperature of HCCPD, the product may solidify and clog or plug various items of equipment.

MITIGATION

Use dry equipment compatible with the spilled product and/or any hydrochloric acid that may be present. Do not undertake this recovery method where liquid HCCPD may solidify during the recovery process unless the product may be maintained as a liquid by some safe means.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product or contaminated runoff may be controlled by absorbing liquids with dry sand, earth, clay, fly ash, cement powder, vermiculite, dicalite, celite, diatomaceous earth, commercial sorbents, or other compatible substances according to various authorities. This response is not applicable for solid HCCPD.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance, particularly in the case of liquids containing or generating hydrochloric acid.

CONSEQUENCE

Application and removal of chemical agents entail additional risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

PROTECTION FROM WIND . . . If deemed necessary due to conditions at the spill site, cover solid HCCPD with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product or its residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable gases present in the area, such as may be generated by the action of hydrochloric acid on many metals, may be ignited by motorized removal equipment.

MITIGATION

Use compatible equipment. Decontaminate all equipment after use. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

HEXACHLOROCYCLOPENTADIENE
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE.. . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. HCCPD will sink to the bottom of water bodies, dissolve at a very slow rate, and react slowly to form hydrochloric acid and possibly other hazardous pollutants. Note that HCCPD is toxic to aquatic life at very low concentrations in water; certain breakdown products may accumulate in the food chain.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air. Wet HCCPD will slowly react with water to form hydrochloric acid that will corrode may metals while generating hydrogen gas.

MITIGATION

Consult qualified experts for guidance. Use compatible equipment or take other precautions if hydrogen gas may pose a fire or explosion hazard.

TECHNIQUE

CONTAINMENT DIKES . . . Water with any dissolved chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to water contaminated by HCCPD, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards, particularly those caused by any hydrochloric acid that may be present or which may be generated.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 1992

HEXAFLUOROACETONE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Hexafluoroacetone is a highly toxic, noncombustible, colorless gas that fumes upon exposure to moist air, that has a musty pungent odor that may be acrid at times, and that is shipped and stored as a liquid under pressure. It is used for making other chemicals and substances used in adhesive, pharmaceutical, solvent, and water-repellent coating formulations. Liquid hexafluoroacetone has a low boiling point and will react vigorously with water or moisture to form an extremely acidic hydrate of the product while generating considerable amounts of heat. All discharges on water or land have the potential to generate relatively large quantities of heavier than air gases and fumes that may be hazardous over considerable downwind distances and that may persist in low areas. The liquid product weighs about 11.1 pounds per gallon under its own vapor pressure at a temperature of 77°F (25°C).

Hexafluoroacetone is stable in normal transportation but containers of the product may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. Information about its reactivity with substances other than water is limited but hexafluoroacetone is generally reported to be a highly reactive substance and is at the very least incompatible with reducing agents, nitrates, and nitric acid. Toxicity of the substance must be considered high by all routes of exposure. Some of its toxic effects are quite unusual and hazardous, especially to pregnant women. When heated to decomposition, hexafluoroacetone is reported to generate fluoride fumes which may possibly include highly corrosive hydrogen fluoride and/or hydrofluoric acid as well as other hazardous substances.

Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, and weather conditions if hexafluoroacetone is leaking from its container. Be advised that the U.S. DOT's 1990 Emergency Response Guidebook recommends immediate initial isolation of the leak area for at least 1500 feet in all directions and then evacuation of a far greater downwind distance in the event of a release from any size container. If a container is exposed to direct flame or a fire becomes uncontrollable, note that it may rupture violently and suddenly release all of its contents into the atmosphere in the form of highly toxic and/or corrosive gases and fumes.

Due to various factors, the available data and information available for this substance were comparatively limited in detail and contained shortcomings. It should not be expected that each and every item of information and recommendation presented below is completely accurate.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts vigorously
Solubility in Other Chemicals: Not available
Specific Gravity (Liquid): 1.32–1.33 at 77°F (25°C) as a liquid under its own vapor pressure.
Boiling Point: –18.4 to –16.6°F (– 28 to – 27°C) at 1 atm.
Melting Point: –187.6°F (–122°C) or – 200.2°F –129°C); reported values vary.
Freezing Point: See melting point
Molecular Weight: 166.02
Heat of Combustion: Not combustible
Vapor Pressure: 5.95 atm (87.5 psia) at 70°F (21.1°C)
Flash Point: Not combustible
Autoignition Temperature: Not combustible
Burning Rate: Not combustible
Stability: Stable in normal transportation
Corrosiveness: Available data are for compatible rather than incompatible materials. All equipment used for hexafluoroacetone should be clean and dry to avoid development of acidic conditions. Monel, nickel, Inconel, stainless steel, copper, and glass or Hastellory C-lined equipment are considered satisfactory for use.
Corrosiveness (continued): Copper tubing can be used for transfer of liquid or gaseous product that is dry. Polyethylene and some types of rubber tubing have been successfully used at times for flexible connections at atmospheric pressure.
Reactivity with Water: Hexafluoroacetone is hygroscopic (i.e., absorbs moisture from the air), will fume when exposed to moist air, and will react vigorously with water or moisture while evolving a considerable amount of heat. The reaction forms highly acidic hexafluoroacetone sesquihydrate with a pH of less than 1.
Reactivity with Other Chemicals: Available data are highly limited. One authority simply reports the product is highly reactive; another reports it also reacts vigorously with substances other than water while releasing considerable heat; and a third recommends the product be kept away from direct sunlight, water, heat, reducing agents, nitrates, and nitric acid. It is best to consider the substance highly reactive and dangerous under these circumstances pending the availability of additional information.

IDENTIFICATION

Shipping Names: Hexafluoroacetone
Synonyms and Tradenames: 1,1,1,3,3,3-Hexafluoro-2-propanone; perfluoroacetone; perfluoro - 2-propanone; GC 7887; HFA; and 6FK.
Chemical Formula: CF_3COCF_3 or $(CF_3)_2C0$
Constituent Components % each): 95% minimum purity; commercial products are more commonly 99.5% or more pure and may exceed 99.9%.
49 STCC: 49 205 28
UN/NA Designation: UN2420
IMO Designation: 2.3, poison gas
Physical State As Shipped: Compressed liquefied gas
Physical State As Released: Fuming and/or boiling liquid, gas, or mixture of gas and aerosols (small liquid droplets); the boiling point of the product is in the range of –18.4 to –16.6°F (– 28 to –27°C) at 1 atm.
Color of the Shipped Material: Colorless gas that fumes when exposed to moist air. Color not available for liquid.
Odor Characteristics: Musty, pungent; becomes acrid in presence of acidic impurities.
Common Uses: Making other chemicals and hexafluoroacetone derivatives used in adhesives, pharmaceutical products, and water repellent coatings for textiles; also used as solvents for resins and polymers

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HEXAFLUOROACETONE
Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available

Unusual Hazards: Extremely volatile substance with poisonous vapors and fumes that are heavier than air and may persist in low areas. Reacts vigorously with water to form highly acidic hydrates while generating considerable heat. Suckback of the product into a container may cause a violent reaction and lead to extremely corrosive conditions.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: (Skin) 0.1 ppm (0.68 mg/m^3) over each 8 hours of a 40 hour work week (ACGIH, 1991– 92; OSHA, 1989).

Conditions to Avoid: Heat or fire; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the high gas, vapor, and fume concentrations that may be present in the spill area and over very considerable distances downwind, but any and all exposures to hexafluoroacetone should be minimized or avoided. Pregnant females appear to be particularly at risk of suffering malformations of fetuses. Males may suffer testicular damage.

Hazards of Skin or Eye Contact: Data are limited. Hexafluoroacetone is simply reported to be severely irritating to the eyes and skin and capable of causing burns. The high acidity of the product in the presence of moisture or water suggests that burns have the potential to be severe and may result in permanent damage to the eyes. Aqueous solutions of hexafluoroacetone and/or its hydrates have been reported to cause the malformation of fetuses in pregnant rats via absorption through the skin when applied daily in repeated doses as low as 1 mg/kg of body weight or in a single application as low as 11 mg/kg. The skin of animals in some of these tests became red and scaly, with burns causing dead skin to be shed in some animals. Absorption through the skin may also cause toxic effects (including effects on the testes of males) and even death in non-pregnant animals, though at higher dosages. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Vapors or fumes of hexafluoroacetone are severely irritating to the eyes, nose, throat, and respiratory tract. Symptoms of exposure are variably reported to include central nervous system depression (with symptoms presumed to include drowsiness, fatigue, incoordination, dizziness, etc.), respiratory system impairment, decreased blood pressure, hemorrhages involving the eyes, pigmented secretions around the eyes and nose, damage to blood cells, injury to the kidneys and liver, damage to the reproductive glands of males (affecting level of sperm production), and irritation of the lungs leading to gross hemorrhages, pulmonary edema (which may be delayed in onset), and death. Exposure of rats to 900 ppm of hexafluoroacetone vapors in air for 30 minutes, to 275 ppm for 3 hours, or to 300 ppm for 4 hours, killed 50% of the animals in laboratory experiments. Exposure to 200 ppm for 4 hours provided evidence of damage to the liver, kidneys, testes, and thymus but was not lethal. Damage to the testes of male rats was reported after a single 4 hour exposure to 60 ppm. There is evidence that exposures can cause malformations in the fetuses of pregnant mammals and subsequent birth defects. Repeated exposures to 12 ppm in air over 90 days caused effects on bone marrow. Repeated exposures have also demonstrated effects on lymph nodes and the spleen in rats and dogs. Some effects, such as reversible kidney injury in rats and increased lung weight in dogs, have been observed after repeated exposures to even 1 ppm in air. Odor is not a reliable warning property of dangerous concentrations of this substance. There is an unconfirmed possibility based on experience with other chemicals that people who have ingested alcohol may be at greater risk of kidney and/or liver damage when exposed to hexafluoroacetone.

Hazards of Ingestion: Data are limited. Due to its low boiling point, ingestion of liquid hexafluoroacetone itself is not considered likely. Nevertheless, experiments with presumably aqueous solutions of the substance have indicated that ingestion of comparatively moderate amounts can cause injury and/or death. The lowest dosage reported to kill rats in laboratory experiments is 191 mg/kg of body weight. The acidity of strong aqueous solutions may be expected to cause burns of the mouth, throat, and gastrointestinal tract with possibly severe consequences.

2420

HEXAFLUOROACETONE
Division 2.3 (Poison Gas)

FIRE HAZARDS

Lower Flammable Limit: Not combustible

Upper Flammable Limit: Not combustible

Behavior in Fire: Liquefied compressed gas. Containers may rupture violently in a fire due to overpressurization and suddenly release all of their contents into the atmosphere in the form of highly toxic and/or corrosive gases and fumes.

Hazardous Combustion Products: Not well-defined. Although the substance is not flammable, various authorities indicate it generates toxic "fluoride" fumes when heated to decomposition. These fumes may possibly contain hydrogen fluoride, hydrofluoric acid, and other hazardous substances such as carbon monoxide and carbon dioxide among others.

EXPLOSION HAZARDS

Lower Explosive Limit: Not combustible

Upper Explosive Limit: Not combustible

Explosiveness: Containers may rupture violently in a fire due to overpressurization. Information on explosions due to reactions with other chemicals is not available.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with hexafluoroacetone and its products of reaction with water or moisture. This may include rubber boots, gloves, face shields, splash-proof and/or gas-tight safety goggles, and other impervious and resistant clothing depending on working conditions. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air under emergency conditions.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full face-piece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, skin, nose, throat, respiratory tract, or other bodily tissues; impaired respiration and/or various other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get immediate medical attention.

First Aid for Ingestion: Ingestion of hexafluoroacetone itself is unlikely due to its low boiling point and is therefore not discussed in reference sources. If an aqueous solution of the product is ingested and the victim is conscious, it appears most prudent to administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to avoid aspiration of fluids into the lungs.

FIRE RESPONSE

Extinguishing Materials: Hexafluoroacetone is not combustible. Use agent suitable for surrounding type of fire but note that liquid hexafluoroacetone reacts vigorously with water with the evolution of considerable heat. The resulting solution may be highly acidic and corrosive.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out, but avoid inadvertently getting water inside containers of

FIRE RESPONSE (continued)

Extinguishing Techniques (continued): hexafluoroacetone or onto any pools of liquid. Do not apply water at point of leak if hexafluoroacetone is discharging from its container. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid all contact with spilled product. Stop leak if safe to do so. Prevent liquid hexafluoroacetone or its solutions from entering sewers. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or other adverse impacts on boilers or industrial process equipment due to the corrosivity and reactivity of the substance and its aqueous solutions. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the high volatility, unusual toxicological characteristics, and reactivity of hexafluoroacetone into account while planning the response. Note that suckback of the product into a container may cause a violent reaction and may lead to the formation of extremely corrosive conditions. To prevent suckback, it is advisable to install a check valve, vacuum break, or trap in transfer lines connected to the container.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Hexafluoroacetone discharges may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hexafluoroacetone vapors or fumes may react with vapors, knockdown vapors and fumes, and/or accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact any pools of liquid hexafluoroacetone itself that may be present. Do not apply water directly on point of leakage.

CONSEQUENCE

Water runoff may contain highly acidic hydrates of hexafluoroacetone from contact with the vapors or fumes of hexafluoroacetone.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid hexafluoroacetone may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Hexafluoroacetone reacts vigorously with water with considerable evolution of heat.

TECHNIQUE *(continued)*

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts for advice as necessary.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid hexafluoroacetone, its solutions, and contaminated runoff may be contained by building dikes or barriers using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate means.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained substances and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible and as appropriate to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment used in attempts to recover liquid hexafluoroacetone itself. Any moisture or water present may result in highly corrosive conditions.

MITIGATION

Use dry, clean equipment compatible with the spilled product and of sufficient pressure capacity. Where necessary, consider using a cold gas such as dry nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of hexafluoroacetone into the equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solutions or contaminated runoff may be controlled by absorbing the liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances. Deposit used sorbents in sealed containers.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

HEXAFLUOROACETONE
Division 2.3 (Poison Gas)

TECHNIQUE (continued)

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify aqueous solutions of hexafluoroacetone to less hazardous substances.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and residues of liquid solutions of hexafluoroacetone may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with contaminant. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid hexafluoroacetone will sink in water while simultaneously boiling and reacting vigorously. The portion that reacts with water will form a highly acidic and toxic solution. The remainder will enter the atmosphere as highly toxic and/or corrosive gases, vapors, and fumes.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1989

HEXAMETHYLENE DIAMINE SOLUTION
Class 8 (Corrosive Materials)

GENERAL INFORMATION

The product solution discussed in this guide is 70% hexamethylene diamine dissolved in water. It is a clear colorless liquid with a weak fishy odor and is used in the making of high polymers such as nylon. A flash point of 160°F for the pure chemical indicates that its solution must be moderately heated before ignition may occur. The solution weighs approximately 7.8 pounds per gallon.

Hexamethylene diamine solution does not react with water or many other common materials and is stable in normal transportation. It is corrosive to aluminum and copper and their alloys, and reacts with oxidizing materials. It is also an irritant via the various routes of exposure and may cause burns of bodily tissues. Toxic vapors are emitted when the materials is heated to decomposition.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol and benzene
Specific Gravity (Liquid): 0.933 at 68°F (20°C)
Boiling Point: 401°F (205°C) at 1 atm. for pure chemical
Melting Point: 28°F (–2°C)
Freezing Point: 28°F (–2°C)
Molecular Weight: 116.21
Heat of Combustion: –6790 cal/g (est.)
Vapor Pressure: Approx 31 mm Hg (0.6 psia) at 230°F (110°C) for pure chemical.
Flash Point: 160°F (71.1°C), open cup for pure chemical.
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Stable
Corrosiveness: Corrosive to aluminum and copper and their alloys.
Reactivity with Water: No reaction; forms alkaline and caustic solution.
Reactivity with Other Chemicals: Reacts with oxidizing materials.

IDENTIFICATION

Shipping Names: Hexamethylene diamine, solution (USDOT); hexamethylenediamine, solution (IMO).
Synonyms and Tradenames: 1,6-Hexanediamine; 1,6-diaminohexane; HMDA.
Chemical Formula: $NH_2(CH2_2)_6NH_2$
Constituent Components (% each): 70% hexamethylene diamine by weight in water.
49 STCC: 49 356 45
UN/NA Designation: UN1783
IMO Designation: 8, corrosive (basic)
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Weak, fishy; like piperidine
Common Uses: Formation of high polymers, especially nylon.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HEXAMETHYLENE DIAMINE SOLUTION
Class 8 (Corrosive Materials)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 0.0009 ppm
Unusual Hazards: Relatively corrosive and combustible liquid.
Short Term Exposure Limits (STEL): Unavailable
Time Weighted Average (TLV-TWA): Unavailable
Conditions to Avoid: Fire or excessive heat; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may possibly be present in the immediate vicinity of the spill. Contact and ingestion are also to be avoided.
Hazards of Skin or Eye Contact: Hexamethylene diamine solution is irritating to the skin and may cause inflammation or burns upon prolonged exposure. Contact with the eyes may cause strong irritation and possibly burns.
Hazards of Inhalation: Vapors of hexamethylene diamine are irritating to the eyes and respiratory tract and are toxic. Exposure to only 158 ppm in air for 10 minutes was fatal to some mice in laboratory experiments.
Hazards of Ingestion: Moderately toxic; may cause burns of the mouth, esophagus, and stomach.

FIRE HAZARDS

Lower Flammable Limit: 0.7%
Upper Flammable Limit: 6.3%
Behavior in Fire: Will burn but may be difficult to ignite unless heated.
Hazardous Combustion Products: Decomposition products are considered toxic and may include oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors from hot liquid are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.
Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.
First Aid for Ingestion: Do not induce vomiting, give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

1783

HEXAMETHYLENE DIAMINE SOLUTION

Class 8 (Corrosive Materials)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water spray. Water may possibly be used to dilute solution to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Hexamethylene diamine solution, usually, will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of hexamethylene diamine solution in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access of unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hexamethylene diamine solution vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain hexamethylene diamine solution from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of hexamethylene diamine solution vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

HEXAMETHYLENE DIAMINE SOLUTION
Class 8 (Corrosive Materials)

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid hexamethylene diamine solution may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as firehose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hexamethylene diamine solution may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as firehose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

HEXAMETHYLENE DIAMINE SOLUTION
Class 8 (Corrosive Materials)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Carbon may be effective on alkaline solutions. Cation exchangers can be used on acid or neutral solutions.)

CONSEQUENCE

Recovery of adsorbents may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

HEXANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Hexane is a clear colorless and fairly volatile liquid hydrocarbon with an odor similar to gasoline. It is used as a general solvent and medium for chemical reactions. Only barely soluble in water and lighter, hexane will form a floating surface slick. Its flash point of – 7°F indicates that the product is easily ignited under most ambient temperature conditions. Vapors are somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.5 pound per gallon.

Hexane does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials, however, and may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low to moderate, but the volatility of hexane indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents. Downwind evacuation should be considered on a case by case basis if hexane is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.014 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohol, chloroform, and diethyl ether.
Specific Gravity (Liquid): 0.659 at 68°F (20°C)
Boiling Point: 155.7°F (68.7°C) at 1 atm.
Melting Point: –139°F (–95°C)
Freezing Point: –139°F (–95°C)
Molecular Weight: 86.17
Heat of Combustion: –10,692 cal/g
Vapor Pressure: 124 mm Hg (2.4 psia) at 68°F (20°C)
Flash Point: – 7°F (– 21.7°C), closed cup.
Autoignition Temperature: 437°F (225°C)
Burning Rate: 7.3 mm/minute
Stability: Stable
Corrosiveness: Noncorrosive to metals but may attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizing materials.

IDENTIFICATION

Shipping Names: Hexane (USDOT and IMO)
Synonyms and Tradenames: Hexyl hydride; normal hexane; n-hexane; Skellysolve B.
Chemical Formula: $CH_3(CH_2)_4CH_3$
Constituent Components(% each): Various grades that are mostly hexane with remainder being petroleum hydrocarbons like cyclopentanes, isohexane, and possibly benzene.
49 STCC: 49 081 83
UN/NA Designation: UN1208
IMO Designation: 3.1, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless *Odor*
Characteristics: Like gasoline
Common Uses: General solvent and extractant; chemical reaction medium for pharmaceuticals; mfg. plastics, adhesives, inks, lacquers, stains, and low temperature thermometers; food additive.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HEXANE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Fairly volatile flammable liquid with somewhat heavier than air vapors. May contain some amounts of toxic benzene.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 50 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in the spill area and some distance downwind. Ingestion and direct contact are also to be avoided. Note that hexane may be a sensitizer of the heart to epinephrine. Any benzene present may increase the acute and chronic health risks of the product.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid hexane may result in drying and cracking of the skin due to the defatting action of the product. Contact of liquid hexane with the eyes may cause irritation.

Hazards of Inhalation: Exposure to appreciable vapor concentrations of hexane in air may cause irritation of the eyes, nose, and respiratory tract. Higher concentrations may cause narcosis and central nervous system depression with symptoms including lightheadedness, giddiness, nausea, headache, dizziness, unconsciousness, and possibly death. Exposure to 5000 ppm in air for only 10 minutes may be sufficient to cause dizziness and the sensation of giddiness.

Hazards of Ingestion: Ingestion may result in nausea, vomiting, swelling of the abdomen, headache, and other signs of central nervous system depression. Aspiration into the lungs during vomiting may cause delayed pulmonary edema or chemical pneumonia with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 1.1–1.2%

Upper Flammable Limit: 7.5–7.7%

Behavior in Fire: Flammable liquid. May generate significant quantities of flammable vapors upon release. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

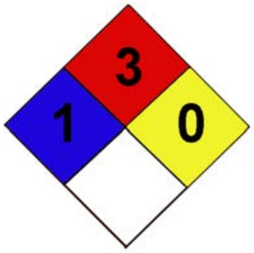
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, chlorinated polyethylene, polyurethane, polyvinyl alcohol, Viton, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (5000 ppm or less) or an organic vapor cartridge respirator (1000 ppm or less) within the uselimitations of these devices.

1208

HEXANE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, respiratory tract, or skin; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Avoid contact with spilled product. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of hexane may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that hexane is a highly flammable substance.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hexane spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Hexane may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of hexane in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

HEXANE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hexane vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of hexane from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of hexane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hexane may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained hexane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material..

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

HEXANE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION .

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

HEXANE
Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating hexane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with hexane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

1-HEXENE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

1-Hexene is a clear liquid with a faint, pleasant odor used as a laboratory reagent. It is typically reported to be 100% pure. Although it's solubility in water is negligible, it is very soluble in benzene, ethyl ether, ethyl alcohol and petroleum ether. It is reported to be stable although it can react violently with heat and strong oxidizing agents. The flash point is very low in the range of -18°C (-0.4°F) to -28°C (-18.4°F), with a lower explosive limit of 1.2% and an upper explosive limit of 6.9% with one source reporting approximately 8.9% as an UEL.

1-Hexene is hazardous through skin or eye contact, inhalation and ingestion. Eye contact with vapor can cause irritation including excessive tearing, blinking and redness, however contact with liquid can be more severe causing possible corneal damage. Skin contact can cause local redness and swelling. Inhalation of vapors can cause irritation to the respiratory tract with possible symptoms including dizziness, drowsiness, headaches, nausea, vomiting, diarrhea, weakness, euphoria, loss of coordination and disorientation. In cases of severe over exposure, unconsciousness or asphyxiation may occur. Ingestion can cause irritation to the gastrointestinal tract including possible symptoms such as abdominal and chest discomfort, nausea, vomiting, diarrhea and weakness. Lung damage may result if aspiration occurs during swallowing or vomiting.

Material is extremely flammable. Explosive mixtures of air and vapor may form, further complicated by the ability of vapors to travel to distant sources of ignition, ignite and flash back. Combustion of 1-Hexene can generate toxic levels of carbon monoxide, carbon dioxide, irritating aldehydes and ketones, while heating to decomposition can cause toxic levels of carbon monoxide, carbon dioxide, acrid smoke and fumes to be produced. Runoff from 1-Hexene may be toxic and/or flammable and must be contained for proper disposal.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible, < .1%
Solubility in Other Chemicals: Very soluble in benzene, ethyl ether, ethyl alcohol, and petroleum ether.
Specific Gravity (Liquid): .673
Vapor Density (Air=1): 3.0
Boiling Point: 63.4°C (146.1°F)
Melting Point: -139.7°C (-219.5°F)
Freezing Point: Not available
Molecular Weight: 84.158
Heat of Combustion: -72.34 ± 1.2 kj/mol
Evaporation Rate (Butyl Acetate=1): 9.6
Vapor Pressure: 7.68 kPa at 0°C (32°F); 24.8 kPa at 25°C (77°F); 64.7 kPa at 50°C(122°F)
Flash Point: -18°C (-0.4°F) to -28°C (-18.4°F)
Autoignition Temperature: 252°C (485.6°F)
Burning Rate: Not available
Flammable Limits: 1.2% (LEL) - 6.9% (UEL) (~8.9% also reported as UEL)
Stability: Stable
Polymerization Potential: Will not occur.
pH: 7
Reactivity and Incompatibility: Can react violently with heat, strong oxidizing agents and acids.
Other Characteristics: Can generate toxic levels of carbon monoxide, carbon dioxide, irritating aldehydes and ketones during combustion or decomposition.

IDENTIFICATION

Shipping Name(s): 1-Hexene (USDOT & IMO)
Synonyms and Tradenames: Butyl Ethylene; Hexene; Hex-1-ene; Hexylene.
CAS Registry No: 592-41-6
Chemical Formula: $CH_2{=}CHCH_2CH_2CH_2CH_3$
Constituent Components (% each): 100% 1-Hexene
UN/NA Designation: UN2370
IMO Designation: 3.1
RTECS Number: MP6600100
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear
Odor Characteristics: Faint, pleasant odor, also described as having a hydrocarbon odor.
Reportable Quantity: See appendix I
Common Uses: Laboratory reagent. Also used in synthesis of flavors, perfumes, dyes and resins.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1-HEXENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Volatile, flammable liquid with a low flash point and heavier than air vapors that can travel to a source of ignition and flash back.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, static, or other sources of ignition and incompatible materials such as strong oxidizing agents and acids.

HEALTH HAZARDS

Potential Health Hazards: 1-Hexene is harmful if absorbed through skin and may cause irritation to eyes and respiratory tract. Aspiration may occur if swallowed. Excessive inhalation may cause central nervous system depression, dizziness, confusion and unconsciousness.

Hazards of Skin or Eye Contact: Vapors from 1-Hexene may cause irritation to the eyes. Symptoms may include excessive tearing, blinking and redness. Liquid 1-Hexene may cause more severe irritation and possible corneal injury. Skin contact may cause irritation or discomfort seen as local redness and possible swelling, as well as other adverse health effects.

Hazards of Inhalation: Vapors or mist may cause irritation to the nose and throat. Symptoms may include dizziness, drowsiness, headaches, nausea, vomiting, diarrhea, weakness, euphoria, loss of coordination, and disorientation. In poorly ventilated areas, confined spaces, or large concentrations, unconsciousness and asphyxiation may occur.

Hazards of Ingestion: Ingestion may cause irritation of mouth, throat, and stomach. Symptoms may include abdominal and chest discomfort, nausea, vomiting, diarrhea, and weakness. Aspiration may occur during swallowing or vomiting, resulting in lung damage.

FIRE HAZARDS

Lower Flammable Limit: 1.2 %

Upper Flammable Limit: 6.9 % (~8.9 % also reported)

Behavior in Fire: Explosive air-vapor mixtures may form. Vapors may travel to distant sources of ignition and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic.

Hazardous Decomposition Products: When heated to decomposition it emits carbon monoxide, carbon dioxide, acrid smoke and fumes.

Hazardous Combustion Products: Toxic levels of carbon monoxide, carbon dioxide and irritating aldehydes and ketones.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Has a relatively low flash point and low autoignition temperature. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas where vapors can accumulate and present an explosive hazard. Containers exposed to prolonged heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

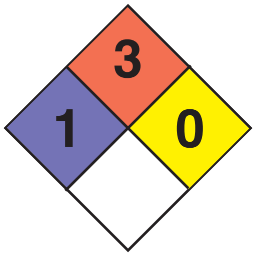
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Full fire retardant structural firefighting clothing meeting NFPA standards is recommended for handling spills when fire is the major concern.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited.

2370

1-HEXENE

Class 3 (Flammable Liquid)



FIRST AID

First Aid for Inhalation: In case of inhalation, remove patient to fresh air. If patient is having difficulty breathing, administer oxygen or if patient is not breathing give artificial respiration. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If patient is conscious and can swallow, give 16 ounces of water but do not induce vomiting. If vomiting occurs, give more water. Have a physician determine if condition of patient permits induced vomiting or evacuation of stomach. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Special Medical Treatment for Physicians: Aspiration of this product during emesis may result in severe lung damage. If evacuation of stomach is necessary, use the method least likely to cause aspiration, such as gastric lavage after endotracheal intubation.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical or alcohol foam, or water spray (fog). Water may be ineffective on flames but should be used to cool fire exposed containers.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: 1-Hexene is a highly flammable liquid that may cause environmental contamination. Material floats on the surface of water. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

1-HEXENE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

MONITOR THE SITUATION . . . Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

1-HEXENE
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

1-HEXENE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . If released into water sources, 1-hexene is expected to float on the surface. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION . . . Material is not water soluble and lighter than water. Overflow dams may be used to confine or divert the spill to a limited area.

CONSEQUENCE

Some material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of any vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Booms may be an effective means to recover spilled material since the material is only slightly water soluble and will float on the surface of the water. Barriers of suitable material may be used to confine the spill to a limited area to prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Constantly monitor the integrity of boom/barriers.

TECHNIQUE

SURFACE SKIMMING . . . Surface skimming may be effective since the material is not water soluble and is lighter than water.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Constantly monitor the integrity of boom/barriers.

August 1997

HYDRAZINE

Class 8 (Corrosive Material) or Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Hydrazine is a colorless, oily, fuming, hygroscopic, highly reactive, corrosive and toxic liquid in concentrations greater than 37%wt. In concentrations less than 37% it is primarily toxic. It has a fishy, ammonia-like odor. It is fully soluble in water and will mix freely. Its flash point of 37.8°C (100°F) indicates that it may be easily ignited under high ambient temperature conditions or when preheated to some degree. Pure liquid hydrazine weighs approximately 8.4 lbs./gallon.

Hydrazine does not react with water and is stable in normal transportation at ordinary ambient temperatures. It is a very strong reducing agent, however, that may ignite in contact with porous organic materials with a high surface area such as rags, cotton, sawdust, etc, and even asbestos. There is a severe explosion hazard if hydrazine is allowed to react with any oxidizing agents, and the product is otherwise reactive with a wide variety of other materials. Toxicity of the product is relatively high by all routes of exposure and the material is considered corrosive to bodily tissues. NIOSH lists hydrazine as a potential occupational carcinogen. Combustion of hydrazine may produce nitrogen oxides.

Downwind evacuation should be considered if hydrazine is leaking but not on fire. Vapors may travel to distant sources of ignition and flash back or accumulate in confined spaces and explode if ignited. Unusual flammability characteristics include a wide range of flammability (2.7-98%), and an autoignition temperature that varies according to the type of material that hydrazine is in contact with, and which can be as low as 23.3°C (73.9°F) in the presence of rusty iron.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in alcohol, ether and other polar solvents.

Specific Gravity: 1.008 at 20°C (68°F)

Vapor Density: 1.1

Boiling Point: 113.5°C (236.3°F)

Melting Point: 1.4-2°C (34.5-35.6°F)

Molecular Weight: 32.05

Heat of Combustion: -622.08 kcal/g

Vapor Pressure: 10 mm Hg (1.33 kPa) at 20°C (68°F)

Flash Point: 51°C (124°F) closed cup.

Autoignition Temperature: Varies from 23.3°C (74°F) in contact with iron rust to 132°C (270°F) in contact with black iron to 156°C (313°F) in contact with stainless steel to 270°C (518°F) in contact with glass.

Burning Rate: 1mm/minute (est.)

Flammable Limits: 2.7-4.7% (LEL) - 98% (UEL)

pH: 10-11

Stability: Stable at ordinary temperature. Can ignite spontaneously on contact with oxidizers and porous materials such as wood or cloth and metal oxides. Thermally unstable.

Polymerization Potential: Will not occur

Corrosiveness: Corrosive to stainless steel with more than 0.5% molybdenum, as well as copper, zinc, lead, iron, bronze, brass, nickel and silver. Will attack glass, rubber and cork.

Reactivity and Incompatibility: Reactions with metallic oxides (rusty) surfaces or porous materials such as wood, asbestos or cloth may result in ignition or flaming decomposition of hydrazine. Reactions with oxidizing agents may result in spontaneous ignition or explosion. Hydrazine is a strong reducing agent that reacts with a wide variety of other chemicals. Catalytic metals such as lead, copper, zinc, cadmium, cobalt, molybdenum, gold, silver and their alloys should be avoided.

IDENTIFICATION

Shipping Name(s): Hydrazine, anhydrous; Hydrazine, aqueous solution; Hydrazine hydrate (USDOT & IMO)

Synonyms and Tradenames: Diamide; Diamine; Hydrazine base. Solutions may be referred to as hydrazine hydrate or diamine hydrate.

CAS Registry No: 302-01-2

Chemical Formula: H_2NNH_2 or N_2H_4

Constituent Components (% each): Anhydrous is 98-100% pure with the rest mostly water and some aniline. Solutions usually contain 35-64% hydrazine in water.

UN/NA Designation: UN2029 (anhydrous greater than 64% wt); UN2030 (hydrate and aqueous solutions between 37 and 64% wt);UN3293 (aqueous solutions not more than 37% wt)

IMO and DOT Designation: 8; 6.1 for solutions of not more than 37% wt.

RTECS Number: MU1750000

NFPA 704 Hazard Rating: 3 (Health): 3 (Flammability): 3 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless oily liquid; may fume when anhydrous. White crystals when solidified. Solutions may be slightly yellow.

Odor Characteristics: Like ammonia; fishy

Reportable Quantity: See appendix I

Common Uses: Rocket fuel, mfg. chemicals, pesticides, plastics, medicines, reducing agent, inorganic solvent, mfg. antioxidants, solder fluxes, explosives, corrosion inhibitors, plating metals on glass or plastic, fuel cells, photo developers, oil-well drilling, etc.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

HYDRAZINE

Class 8 (Corrosive Material) or
Division 6.1 (Poisonous Material)

*Also 2030

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 3-4 ppm

Unusual Hazards: Fuming, hydroscopic, highly reactive, flammable, corrosive and toxic liquid. Vapors of heated liquid may travel to a source of ignition and flash back. Hydrazine may continue to burn in the absence of air. NIOSH has identified hydrazine as a potential occupational carcinogen.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.04 mg/m^3 (2-hr.)

Ceiling (C) Limit: 0.03 ppm

IDLH: 50 ppm

Conditions to Avoid: Heat, fire and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Potential Health Hazards: Major hazard is from exposure to the high vapor concentrations that may be present in the spill area and downwind. Ingestion and physical contact are also to be strictly avoided. NIOSH has identified hydrazine as a potential workplace carcinogen.

Hazards of Skin or Eye Contact: Hydrazine is a severe skin and mucous membrane irritant. It may cause severe burns of the skin, may be absorbed through the skin in toxic amounts and may lead to allergic sensitization. Contact of liquid hydrazine with the eyes may result in severe injury and permanent damage. Even exposure of the eyes to high vapor concentrations in air can cause temporary blindness lasting up to 24 hours.

Hazards of Inhalation: Hydrazine vapors are immediately irritating to the nose and throat and cause dizziness and nausea, as well as itching, burning and swelling of the eyes over time. Vomiting and excited behavior may follow as the central nervous system is effected. Excessive exposures may result in convulsions, bronchitis, pulmonary edema, liver and kidney damage and possibly death.

Hazards of Ingestion: Ingestion of hydrazine may result in weakness, vomiting, excitement, convulsions, liver and kidney damage, other symptoms reported above and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 4.7% (some reference sources say 2.9%)

Upper Flammable Limit: 98%

Behavior in Fire: Flammable liquid in concentrations greater than 64% will generate large quantities of flammable gas or vapor upon release when hot. Vapors may travel to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Decomposition Products: Nitrogen, ammonia.

Hazardous Combustion Products: May include ammonia and nitrogen oxides.

EXPLOSION HAZARDS

Explosive Potential: Explosive when heated or in contact with oxidizers. Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

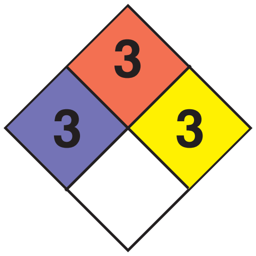
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Compatible materials may include butyl rubber, natural rubber and polyvinyl chloride. For hydrazine Tychem® SL, Tychem®9400, and Barricade® (longer than 8 hours). For

2029*

*Also 2030 or 3293

HYDRAZINE

Class 8 (Corrosive Material) or
Division 6.1 (Poisonous Material)



hydrazine hydrate, 51%, Tychem® 10,000 (longer than 8 hours). Structural firefighting protective clothing does not provide an adequate level of personal protection for this product.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a positive-pressure, self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent) is recommended. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; dizziness, nausea or other symptoms of exposure.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if burning or irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not induce vomiting without advice from a physician. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Foam, carbon dioxide, dry chemical and/or water. Flooding with water is necessary to prevent reignition. Water may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Unusual toxic and corrosive fume hazard. Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. Do not walk through spilled material. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, to protect personnel and dilute to nonflammable limits. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain corrosive and/or toxic gases.

SPILL RESPONSES

General Information: Hydrazine is a highly toxic, flammable and reactive material that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors and delete to nonflammable limit. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Due to the low vapor pressure and high boiling point hazardous vapor concentrations should not occur beyond the immediate spill area. However, continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapor, especially if a large spill and fire is involved.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable, corrosive and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents may be applied to the surface of liquid pools to reduce vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid may slow the release of vapors into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination.

HYDRAZINE

Class 8 (Corrosive Material) or Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product. At low ambient temperatures, the liquid may solidify.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Keep from solidifying to maintain suction or resort to mechanical removal of solid material. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, dry dolomite, dry vermiculite or other similar nonporous noncombustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product.

HYDRAZINE

Class 8 (Corrosive Material) or Division 6.1 (Poisonous Material)

WATER SPILL

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Hydrazine and its solutions are fully soluble in water and will rapidly dissolve. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 2006

HYDROCHLORIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Hydrochloric acid, also known as muriatic acid (in lower concentrations), is a colorless to light yellow volatile, fuming liquid with a sharp pungent, and irritating odor. It is used to make fertilizers, dyes and dyestuffs, artificial silk, pigments, and a variety of other chemicals; it also has uses in electroplating, soap and edible oil refining, leather tanning, ore refining, petroleum extraction, and a wide range of other processes. It is not flammable but contact with many metals produces flammable and potentially explosive hydrogen gas. The product is completely soluble in water and weighs approximately 9.9 pounds per gallon. It is formed by dissolving hydrogen chloride (HCl) gas in water, and solutions may contain as much as 40% hydrogen chloride.

Hydrochloric acid is stable in normal transportation but may react with water, generating heat and corrosive and/or toxic vapors. Vapors are heavier than air and may accumulate in low lying or confined areas, such as basements, ditches, tanks, hopper/tank cars etc. It is highly corrosive to most metals and reacts with a wide variety of other chemicals and substances. Spills of the product may generate gases and vapors which are highly corrosive to bodily tissues. Any contact with the liquid may result in acid burns. Many solutions of hydrogen chloride have a high vapor pressure, thereby releasing high amounts of toxic and corrosive vapors in the air.

If hydrochloric acid is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in alcohol

Specific Gravity (Liquid): 1.19 at 68°F (20°C) for 38% HCl

Vapor Density: Approximately 1.3

Boiling Point: Varies with composition, but at or above 123°F (50.5°C)

Melting Point: Varies with composition. Usually around –87 to –101°F (–66 to –74°C)

Freezing Point: Varies with composition

Molecular Weight: 36.46 (for HCl); may form higher weight hydrates.

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): Reports vary; 1 – 2

Vapor Pressure: Varies with composition. Reports vary from 84 mmHg to 210 mmHg at 68°F (20°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Flammable (Explosive) Limits: Not flammable

Stability: Stable

Polymerization Potential: Will not occur

pH: 0.1 – 2.02

Corrosiveness: Corrosive to most metals, particularly iron and aluminum, with evolution of hydrogen gas.

Reactivity with Water: No reaction, but may generate heat.

Reactivity with Other Chemicals: Reacts with most metals; alkali or active metals and certain of their compounds; acetic anhydride; 2-amino ethanol; ammonium hydroxide; chlorosulfonic acid; oleum; sulfuric acid; ethylene diamine or imine; propylene oxide; vinyl acetate; B propiolactone; $HClO_4$; hydroxides; cyanides; sulfides; strong oxidizers; carbonates; hypochlorites and formaldehyde and a variety of other chemicals.

IDENTIFICATION

Shipping Names: Hydrochloric acid (USDOT & IMO)

Synonyms and Tradenames: Muriatic acid; Aqueous hydrogen chloride

CAS Registry No.: 7647-01-1

Chemical Formula: HCl (dissolved in H_20)

Constituent Components(% each): <10 – 40% HCl in water

UN/NA Designation: UN1789

IMO Designation: 8, corrosive substances

RTECS Number: MW4025000

NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 0 (Instability)

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless to light yellow; spent acid may be dark.

Odor Characteristics: Sharp, pungent, irritating

Reportable Quantity: See Appendix I

Common Uses: Mfg. of fertilizers, dyes, dyestuffs, artificial silk, paint pigments, other chemicals; food industry, scale removal, metal cleaning, pH adjustment, industrial acidizing; refining soap, ore, or edible oils; petroleum extraction; electroplating; leather tanning; pickling of metals; uses in photographic, textile, and rubber industries.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

HYDROCHLORIC ACID

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not well defined, may be 1–5 ppm
Unusual Hazards: Highly corrosive acid that generates heavier than air vapors and gases; may generate hydrogen gas upon contact with metals.
Short Term Exposure Limits (STEL): Unavailable
Time Weighted Average (TLV-TWA): Unavailable
Ceiling (C) Limit: 5 ppm (7 mg/m^3) (NIOSH & OSHA)
IDLH: 50 ppm
Conditions to Avoid: Excessive heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to high vapor or gas concentrations in air but all exposures should be strictly avoided.
Hazards of Skin or Eye Contact: Hydrochloric acid and its vapors and gases may rapidly cause skin inflammation or burns. Effects range from dermatitis, redness, swelling, pain, and permanent scarring, to death. Contact with the eyes may result in eye irritation, severe burns, and permanent damage with possible loss of sight.
Hazards of Inhalation: Vapors or gases evolved from hydrochloric acid may cause irritation of the respiratory tract with burning, choking, and coughing. High concentrations in air may result in ulceration of the nose and throat, severe delayed breathing difficulties involving pulmonary edema, laryngeal edema or spasm, and possibly death.
Hazards of Ingestion: Ingestion of concentrated acid may result in burns of the mouth, throat and stomach, pain, nausea, vomiting, and possibly death due to esophageal or gastric necrosis.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Not flammable
Upper Flammable (Explosive) Limit: Not flammable
Behavior in Fire: There is a limited possibility that containers may rupture in fire due to over-pressurization. May generate large quantities of corrosive gas or vapors upon release.
Hazardous Decomposition Products: May generate flammable, potentially explosive hydrogen gas on contact with most metals. Explosive concentrations of hydrogen may accumulate inside metal equipment. Hydrochloric acid vapors may be released from heating under fire conditions.

EXPLOSION HAZARDS

Explosive Potential: There is a limited potential that containers may rupture in fire due to over-pressurization. Contact with most metals produces hydrogen gas that may explode if ignited in confined spaces.

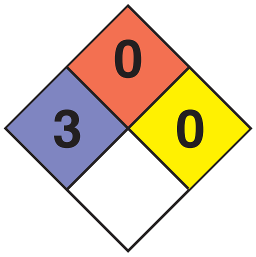
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor concentrations in air. Compatible materials may include neoprene, latex or rubber, nitrile latex, butyl rubber, natural rubber, nitrite rubber, nitrite rubber/polyvinyl chloride, chlorinated polyethylene, polyvinyl chloride, styrene-butadiene rubber, Viton®, nitrite-butadiene rubber, Saranex®, and polycarbonate. The following materials are reported to have a greater than 8 hour breakthrough time: butyl; Teflon®; Saranex®; Barricade®; Trellchem®; Tychem® CPF 2; Tychem® SL; Tychem® CPF 3; Tychem® CPF 4; Tychem® BR; Tychem® LV; Tychem® TK; Tychem® F; Tychem® Reflector®; Tychem® CPE; Tychem® Butyl and Tychem® ThermoPro; Chem Master gloves; Ultraflex Nitrile 22R gloves; Viton® 890 gloves; Neoprene 6780 gloves; Viton 892® gloves; Nitty Gritty 65NFW gloves; Butyl 878 gloves; Hustler PVC 725R gloves; Butyl 874R gloves; Ultraflex Neoprene 32 gloves; N-DEX 8005 gloves; Chloroflex 723 gloves; Neo. Chloroflex N5/N8 gloves; Nitri Solve 727. The following materials are reported to have a greater than 4 hour breakthrough time: neoprene; PVC; Tychem® Responder®; Tychem® Responder® CSM.

1789

HYDROCHLORIC ACID

Class 8 (Corrosive Material)



Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm): a self-contained breathing apparatus (SCBA) with full facepiece; any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 50 ppm): any air-purifying half-mask respirator equipped with cartridge(s) providing protection against hydrogen chloride; any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against hydrogen chloride; any powered air-purifying respirator with cartridge(s) providing protection against hydrogen chloride; any supplied-air respirator. NOTE: Eye protection may be required in addition to the respirator.

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; choking, coughing and other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of water until all traces of material are gone or for 20 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, vapor suppressant foam, dry sand, carbon dioxide, dry chemical or as necessary for surrounding fire. Note: Most foams may react with the material and release corrosive/toxic gases.

Extinguishing Techniques: Corrosive vapor hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense vapors/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. Do not get water inside containers. Take into account while planning the response that fuming hydrochloric acid is highly corrosive and that contact with metals may produce flammable and potentially explosive hydrogen gas.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers or confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that fuming hydrochloric acid is highly corrosive and that contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. A vapor suppressing foam or water spray may be used to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.

HYDROCHLORIC ACID

Class 8 (Corrosive Material)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Hydrochloric acid, especially the solid, may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill by checking for pH until the spilled product is removed.

CONSEQUENCE

Hazardous levels of hydrochloric acid in air may be found in the local spill area and immediately downwind, particularly if an acid mist is somehow generated in higher concentration solutions.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrochloric acid vapors or fumes may absorb vapors, knockdown vapors, and accelerate their dispersal in the atmosphere. Do not allow run off to contact spilled pool. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Water runoff may contain hydrochloric acid from contact with its vapors.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

VAPOR SUPPRESSANT FOAM . . . Vapor Suppressant foam may be applied to the surface of liquid pools accumulated in depth, which may slow the release of vapors in the atmosphere. Note: Application of some vapor suppressant foams may initially increase the rate of vaporization until the entire surface of the spill is covered.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid hydrochloric acid may eventually slow the release of vapors into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hydrochloric acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained hydrochloric acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

HYDROCHLORIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. NOTE: Hydrochloric acid is corrosive to many metals and may create flammable gas upon reaction.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent, such as sodium bicarbonate or soda ash, may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

HYDROCHLORIC ACID

Class 8 (Corrosive Materials)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

HYDROCYANIC ACID
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Hydrocyanic acid is a colorless gas (hydrogen cyanide) that is shipped as a pure liquid under pressure or may be dissolved in water to form aqueous solutions of various strengths. This guide is primarily intended for the pure liquefied gas. Although hazards of aqueous solutions are usually less severe and physical properties may differ, much information here is generally applicable to such solutions if properly interpreted. Pure hydrocyanic acid is fully soluble in water, has a sweetish odor like almonds, a boiling point of 78.3°F, and a flash point of 0°F. The pure liquid may boil at high ambient temperatures or otherwise rapidly evaporate, thus producing large amounts of highly toxic and flammable vapors which may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat (see below also). The liquid weighs about 5.7 pounds per gallon.

Hydrocyanic acid dissolves in water with a moderate reaction and may become unstable if stored for extended time or exposed to high temperature and pressure. It is incompatible with alkalis and may attack some forms of plastics, rubber, and coatings, but is considered noncorrosive to most metals. It is a highly toxic substance by all routes of exposure, including absorption through the skin, and is considered a poison. Products of combustion are toxic and may include unburned cyanides and nitrogen oxides. However, if the material is on fire do not extinguish the fire. The combustion products pose a less air pollution hazard than the unburned chemical.

If on fire, do not extinguish unless flow can be stopped. If liquid hydrocyanic acid or its aqueous solutions (classed as Poison A by USDOT) are leaking or are involved in a fire, evacuate for a radius of 2500 feet. If aqueous solutions of hydrocyanic acid (classed as Poison B by USDOT) are leaking, downwind evacuation should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol
Specific Gravity (Liquid): 0.689 at 68°F (20°C)
Boiling Point: 78.3°F (25.7°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: 8.1°F (–13.3°C)
Molecular Weight: 27.03
Heat of Combustion: –5864 cal/g
Vapor Pressure: 620 mm Hg (11.98 psia) at 68°F (20°C)
Flash Point: 0°F (–17.8°C), closed cup
Autoignition Temperature: 1004°F (540°C)
Burning Rate: 1.8 mm/minute
Stability: May become unstable and subject to explosion if stored for extended time or exposed to high temperature and pressure.
Corrosiveness: Noncorrosive to most metals; may attack some plastics, rubber, or coatings.
Reactivity with Water: Dissolves with moderate reaction
Reactivity with Other Chemicals: Reacts with alkalis and bases such as caustics and amines (may polymerize), acetaldehyde, and oxidizers.

IDENTIFICATION

Shipping Names: Hydrogen cyanide, stabilized (USDOT & IMO); Hydrogen cyanide, solution in alcohol (USDOT & IMO); Hydrocyanic acid, liquefied (USDOT & IMO); Hydrocyanic acid solution, less than 5% hydrocyanic acid (USDOT); Hydrogen cyanide, aqueous solution (USDOT & IMO); Hydrocyanic acid, aqueous solutions (USDOT & IMO).
Synonyms and Tradenames: Hydrogen cyanide, prussic acid, HCN, acid liquid HCN, carbon hydride nitride, cyclon, formic anammonide, formonitrile, anhydrous hydrocyanic acid.
Chemical Formula: HCN
Constituent Components(% each): 96% pure with 0.05% phosphoric acid as stabilizer; may also be aqueous solution.
UN/NA Designation: UN1051 (USDOT and IMO); UN1613 (USDOT and IMO); UN1614 (USDOT and IMO); UN3294
IMO Designation: 6.1 poisonous substance.
Physical State as Shipped: Liquid
Physical State as Released: Liquid or gas (boils at 78.3°F)
Color of the Shipped Material: Colorless to bluish white
Odor Characteristics: Sweetish, like bitter almonds, but some people may not smell odor.
Common Uses: Fumigation; mfg. plastics, dyes, pharmaceuticals, insecticides, rodenticides, and other chemicals; used in electroplating, mining, and metallurgy.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

HYDROCYANIC ACID

Division 6.1 (Poisonous Material)

Square background applicable to rail cars.
Also see "UN/NA Designation" for additional numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.2-5 ppm (if evident)

Unusual Hazards: Extremely toxic, flammable substance that may be hazardous over considerable downwind distances. Storage of more than 90 days, excessive heat, or chemical contamination may result in explosive polymerization.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): (Skin) 10 ppm absolute ceiling limit.(ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Vapors may be toxic over considerable downwind distances. All exposures should be strictly avoided.

Hazards of Skin or Eye Contact: Liquid hydrocyanic acid and its concentrated vapors have little or no irritant effect on the skin but may be rapidly absorbed in toxic amounts. Contact with the eyes may cause local irritation and may also result in hazardous absorption.

Hazards of Inhalation: Relatively low concentrations in air may cause weakness, headache, confusion, occasional nausea and vomiting, difficult breathing, cyanosis, and convulsions. Higher levels may cause rapid unconsciousness and death. Opinions vary, but many state that 270 ppm is rapidly fatal while 110 ppm is fatal in one hour; 45-54 ppm may cause symptoms in 30-60 minutes.

Hazards of Ingestion: The ingestion of as little as 50-100 mg (0.0035 ounce or less) may be fatal.

FIRE HAZARDS

Lower Flammable Limit: 5.6-6%

Upper Flammable Limit: 40-41%

Behavior in Fire: Flammable liquefied gas or liquid. May generate large quantities of flammable and toxic vapors upon release. Vapors may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in explosive polymerization.

Hazardous Combustion Products: Toxic, may include unburned cyanides and nitrogen oxides.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of stabilizer or excessive heat may cause polymerization resulting in violent container rupture. Polymerization may also occur in the presence of bases or alkalis.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, neoprene, polyvinyl chloride, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1051

HYDROCYANIC ACID
Division 6.1 (Poisonous Material)

See "UN/NA Designation" for
additional other ID numbers.

FIRST AID

Nonspecfic symptoms: Headache, weakness, other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If available and necessary, administer amyl nitrite pearl in cloth one inch from mouth and nostrils for 15 seconds. Repeat 5 times at 15-second intervals. Use fresh pearl every 5 minutes until 3-4 have been used.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. Administer amyl nitrite if necessary and available.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. Administer amyl nitrite if necessary and available for cyanide poisoning.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective but may be used to dilute spill to nonflammable mixture. Be cautious of possible water reaction.

Extinguishing Techniques: Unusual toxic vapor hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture, or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that hydrocyanic acid is extremely volatile, toxic, and flammable when concentrated. Accumulations of heavy gas may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrocyanic acid spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HYDROCYANIC ACID
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrocyanic acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain hydrocyanic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of hydrocyanic acid vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply alternative technique if response is ineffective. Proceed with caution.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hydrocyanic acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained hydrocyanic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

HYDROCYANIC ACID
Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

HYDROCYANIC ACID
Division 6.1 (Poisonous Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Proceed with caution. Consult qualified experts for safe treatment or neutralizing techniques.

January 1989

HYDROFLUORIC ACID
Class 8 (Corrosive Materials)

GENERAL INFORMATION

Hydrofluoric acid is an extremely corrosive, nonflammable, colorless to slightly yellow fuming liquid that has a penetrating, irritating, pungent, and sharp odor and that consists of hydrogen fluoride (usually 30–70% by weight) dissolved in water. It is used for polishing, etching, and frosting glass; pickling, electropolishing, cleaning, and treating various metals; dissolving ores; and for a wide variety of other purposes. The acid is completely soluble in water and will mix rapidly while generating heat. Although hydrofluoric acid is not itself flammable, contact with some metals may liberate flammable and potentially explosive hydrogen gas. Containers may rupture violently due to overpressurization if exposed to excessive heat or fire for sufficient time duration, especially if the acid is concentrated. The liquid weighs approximately 9.2 to 10.5 pounds per gallon with its specific weight depending on temperature and concentration.

Hydrofluoric acid is stable in normal transportation but is highly reactive with a wide variety of other chemicals and materials. It is among the most corrosive of all acids and will attack natural rubber, leather, many organic materials, glass, concrete, and certain metals, especially those like cast iron that contain silica. It is also extremely corrosive to bodily tissues and may cause severe, painful, deep, and slow healing burns that may be delayed in onset.

If hydrofluoric acid is leaking and generating vapors or fumes, downwind evacuation should be considered until properly equipped responders have evaluated the hazard. Note that the degree of hazard will depend on the amount of acid spilled and the concentration of hydrogen fluoride in solution. Large spills of concentrated acid may require evacuation over considerable downwind distances.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol
Specific Gravity (Liquid): 1.1–1.26; varies with temperature and concentration.
Boiling Point: 150.8 –152.6°F (66 – 67°C) for 70%; 226.4°F (108°C) for 48%; 248°F (120°C) for 35.35% solution at 1 atm.
Melting Point: – 95.8 to – 92.2°F (– 71 to – 69°C) for 70%; –34.6°F (–37°C) for 48%; –31°F (–35°C) for 35.35% solution.
Freezing Point: See melting point
Molecular Weight: 20.01 (for HF); may be higher for associated molecules in air; e.g., 49.08 at 68°F (20°C).
Heat of Combustion: Not flammable
Vapor Pressure: 10 mm Hg (0.1933 psia) for 48%; 110 mm Hg (2.126 psia) for 70%; both at 68°F (20°C).
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: *Will* attack natural rubber, leather, many organic matters, glass, concrete, certain metals (especially those like cast iron that contain silica), and many other substances. Contact with silicon-bearing materials (including sand, glass, and ceramics) may generate silicon tetrafluoride gas.
Reactivity with Water: Dissolves with generation of heat.
Reactivity with Other Chemicals: Reacts (possibly violently) with a wide variety of materials including arsenic trioxide, phosphorus pentoxide, bismuthic acid, nitric acid, fluorine, sodium, cyanides, sulfides, acetic anhydride, 2-amino ethanol, ammonium or sodium hydroxide; calcium oxide, chlorosulfonic acid, ethylenediamine, ethyleneimine, oleum, betapropiolactone, propylene oxide, sulfuric acid, vinyl acetone, strong alkalies, and others. Contact with sulfides may liberate toxic hydrogen sulfide gas. Contact with cyanides may liberate toxic hydrogen cyanide gas.

IDENTIFICATION

Shipping Names: Hydrofluoric acid solution (USDOT and IMO); fluoric acid (USDOT and IMO).
Synonyms and Tradenames: Hyfluoric acid; fluoric acid; fluohydric acid; fluorhydric acid; hydrogen fluoride aqueous solution; aqueous HF.
Chemical Formula: HF (in water)
Constituent Components (% each): Shipped as various strength solutions usually containing 30 – 70% hydrogen fluoride by weight in water but some solutions may be more dilute.
49 STCC: 49 300 22
UN/NA Designation: UN1790
IMO Designation: 8, corrosive
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless to slightly yellow liquid; may fume in air if not too dilute.
Odor Characteristics: Sharp; irritating; pungent; penetrating
Common Uses: Polishing, etching and frosting glass; pickling copper, brass, stainless and other alloy steels; electropolishing metals; cleaning castings; dissolving ores; acidizing oil wells; making fluorinated chemicals and plastics; laundry sour; separating uranium isotopes; treatment of ceramic, iron, and aluminum surfaces; dye chemistry; gasoline refining.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROFLUORIC ACID
Class 8 (Corrosive Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.036–0.132 ppm

Unusual Hazards: Extremely corrosive and reactive liquid that may fume in air. Contact with some metals may liberate hydrogen gas.

Short Term Exposure Limits (STEL): Unavailable Time Weighted Average (TLV-C):

Conditions to Avoid: Excessive heat or fire; sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly toxic and corrosive by all possible routes of exposure. Fumes and vapors from the concentrated acid may be hazardous over considerable downwind distances in air. Note that solutions as dilute as 2% or lower by weight may cause burns to bodily tissues. Symptoms may not appear for some time after exposures.

Hazards of Skin or Eye Contact: Contact of the skin with hydrofluoric acid or its fumes may result in severe slow-healing and painful burns and ulcers involving localized death of the skin and deep tissue and possible decalcification of bone. Effects may be delayed up to 24 hours for 20% or less solutions and 1– 8 hours for 20 – 50% solutions. Contact with the eyes may also cause severe irritation and deep burns possibly resulting in blindness or other permanent defects in vision. Do not wear contact lenses when working with this product.

Hazards of Inhalation: Hydrofluoric acid vapors and fumes are severe respiratory system irritants that may cause choking, coughing, difficult breathing, burns of the nose, throat and upper respiratory tract, and bronchitis. Excessive exposures may cause rapid inflammation and congestion of the lungs, severe breathing difficulties, fever, cyanosis, and death from pulmonary edema. Some severe effects may be delayed in onset by hours or even days. Concentrations of 50–250 ppm in air are considered dangerous to humans in even brief exposures. Levels of 456 to 1774 ppm for one hour were fatal to *50%* of various animals in laboratory experiments.

Hazards of Ingestion: Ingestion of hydrofluoric acid may cause severe burns of the mouth, throat and stomach, nausea, vomiting, pain, diarrhea, kidney injury, profound hypocalcemia, circulatory collapse, and death.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization, particularly if acid is concentrated. May generate large quantities of corrosive vapors and fumes upon release.

Hazardous Combustion Products: Not flammable but hydrogen fluoride gas may evolve upon heating.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Containers may rupture violently in fire due to over-pressurization, particularly if acid is concentrated. Contact with some metals may liberate hydrogen gas that may explode if ignited in a confined space. Contact with sodium may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials for 30 – 70% solutions in water may include neoprene, nitrile rubber, Viton, and nitrile butadiene rubber according to an EPA guide. Polyvinyl chloride is listed as compatible by two makers of hydrofluoric acid.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 20 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted hydrogen fluoride canister and filter or a chemical cartridge respirator with a full facepiece and providing protection against hydrogen fluoride within the use limitations of these devices.

1790

HYDROFLUORIC ACID
Class 8 (Corrosive Materials)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; choking, coughing, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. Pay special attention to skin under nails. If available after washing of skin, immerse burned skin area in 0.2% iced aqueous hyamine 1622 or 0.13% iced aqueous zephiran chloride solution. Next best is saturated solution of epsom salts or iced 70% alcohol or iced benzalkonium chloride solutions.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. Give more water if vomiting occurs naturally.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account when planning the response that hydrofluoric acid is an extremely corrosive substance and that contact with some metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof tools and equipment where necessary.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrofluoric acid spills may expose downwind areas to toxic concentrations over considerable distances in some cases if large quantities of corrosive fumes or gas are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HYDROFLUORIC ACID
Class 8 (Corrosive Materials)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrofluoric acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain hydrofluoric acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid hydrofluoric acid may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid hydrofluoric acid may eventually slow the release of vapors or fumes into the atmosphere. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hydrofluoric acid may be contained by building dikes using soil or other compatible substances. Note that the acid will react with sand and other materials containing silica and release toxic and corrosive silicon tetrafluoride gas.

CONSEQUENCE

Contained hydrofluoric acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

HYDROFLUORIC ACID
Class 8 (Corrosive Materials)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with earth, fly ash, cement powder, commercial sorbents, or other compatible substances. Note that hydrofluoric acid reacts with silicon-bearing materials such as sand.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Apply technique to remove final traces of spilled product or to remove products of neutralization.

HYDROFLUORIC ACID
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

HYDROFLUOROSILICIC ACID
Class 8 (Corrosive Material)

GENERAL INFORMATION

Hydrofluorosilicic acid, also known as hydrofluosilicic acid, is a colorless to straw colored fuming liquid with an acrid, sour, and pungent odor. It is used for electropolishing metals, particularly aluminum. Its sodium salt is used to harden cement and ceramics, as a wood preservative, in paints, for making synthetic cryolite in aluminum production, and in water fluoridation. The acid is fully soluble in water and nonflammable. It weighs approximately 10.8 pounds per gallon.

Hydrofluorosilicic acid dissolves in water with the evolution of heat and is stable in normal transportation. It is reactive with a variety of chemicals and combustible materials, and will corrode most metals while producing flammable and potentially explosive hydrogen gas. The liquid and its vapors are also corrosive to bodily tissues. Corrosive and toxic fumes of hydrogen fluoride may be generated in fires.

Downwind evacuation should be considered on a case by case basis if spills of hydrofluorosilicic acid generate large amounts of fumes or mists into air.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Slightly soluble in alkaline solutions.

Specific Gravity (Liquid): Approx. 1.3 at 77°F (25°C)

Boiling Point: Approx. 212°F (100°C) - decomposes

Melting Point: See freezing point

Freezing Point: –24 to –4°F (–31 to –20°C) (typical)

Molecular Weight: 144.09 (solute only)

Heat of Combustion: Not flammable

Vapor Pressure: Unavailable, may fume

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Corrodes most metals with evolution of hydrogen gas.

Reactivity with Water: No reaction, but evolves heat while mixing.

Reactivity with Other Chemicals: May react with oxidizers, alkali metals, combustible materials, organic peroxides, arsenic trioxide, and phosphorus pentoxide.

IDENTIFICATION

Shipping Names: Fluosilicic acid (USDOT & IMO).

Synonyms and Tradenames: Hydrosilicofluoric acid; hydrofluosilicic acid; fluorosilicic acid; fluosilicic acid; hexafluosilicic acid; hydrogen hexafluorosilicate; sand acid; silicofluoric acid.

Chemical Formula: H_2SiF_6 in H_2O

Constituent Components(% each): 22-30% solutions in water

UN/NA Designation: UN1778

IMO Designation: 8, corrosive

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless to straw colored

Odor Characteristics: Acrid, sour, pungent

Common uses: Electropolishing metals; sodium salt used to harden cement and ceramics, as wood preservative, to make synthetic cryolite, in technical paints, and for water fluoridation.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROFLUOROSILICIC ACID
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Corrosive acid that may fume in air. Evolves hydrogen gas in contact with most metals.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat or fire; sparks or fire where hydrogen may be present, contact with incompatible materials; runoff to sewers or waterbodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact with liquid hydrofluorosilicic acid or its concentrated vapors or fumes in air may cause severe burns of the eyes or skin.

Hazards of Inhalation: Fumes or vapors of hydrofluorosilicic acid are severely corrosive to the mucous membranes and may irritate or injure the respiratory tract if inhaled.

Hazards of Ingestion: Ingestion may result in severe burns of the mouth and stomach.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May generate corrosive fumes or vapors upon release. May decompose in fire to produce toxic and corrosive fumes of hydrogen fluoride.

Hazardous Combustion Products: See behavior in fire.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Contact with most metals produces hydrogen gas that may explode if ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encpasulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air, where such concentrations are evident.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: Treat as for hydrogen fluoride burns with iced benzalkonium soaks.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

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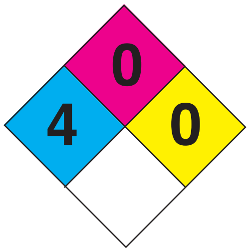
HYDROFLUOROSILICIC ACID

Class 8 (Corrosive Material)



FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may be dangerous. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that hydrofluorosilicic acid is highly corrosive and that contact with most metals evolves hydrogen gas. Use explosion-proof and spark-proof equipment where necessary.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrofluorosilicic acid spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts of fumes are generated from spills.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION ... Hydrofluorosilicic acid may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the acid is not fuming or small amounts have spilled.

CONSEQUENCE

Hazardous levels of hydrofluorosilicic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to hydrofluorosilicic acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain hydrofluorosilicic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

HYDROFLUOROSILICIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

DILUTION ... The addition of a relatively large amount of water to liquid hydrofluorosilicic acid may slow the release of vapors into the atmosphere. Apply water cautiously at first to ensure lack of a hazardous reaction.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent to liquid hydrofluorosilicic acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Hydrofluorosilicic acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained hydrofluorosilicic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for ground water contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread ofcontamination. Use surface dikes or barriers where ground water contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

HYDROFLUOROSILICIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product.Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

Containment dikes ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

HYDROFLUOROSILICIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled withcare. Improper application may lead to increased damage or harm. (Note: Salts formed in neutralization are also toxic.)

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

August 1997

HYDROGEN (Refrigerated Liquid or Compressed)

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Hydrogen is a colorless and odorless gas sometimes transported as a refrigerated liquid. It is commercially produced, although not the only means, by reaction of methane with steam at 830°C (1526°F) in the presence of a nickel catalyst. Hydrogen is the element with the lowest atomic number and forms a bond with another hydrogen molecule to form H_2. It is essentially 100% pure although trace amounts of helium and hydrocarbon gas such as methane may be found. Hydrogen has many uses including the hydrogenation of vegetable and animal oils and fats, prevention of oxidation of metals, welding and cutting, petroleum refining, production of ammonia, methanol, aniline and some inorganic acids and fuel. It is stable, although any source of ignition should be avoided. Incompatible materials include, but may not be limited to, air, oxygen, oxidizing agents, lithium, halides, alkali metals, metal catalysts, nitrogen trifluoride, oxygen difluoride, and halogens. Its solubility in water is negligible and it is slightly soluble in ethanol and ether.

Hydrogen is essentially non-toxic. The primary route of entry is inhalation of the gas, although the liquid form may cause frostbite like burns to the eyes and skin. Inhalation in moderate amounts may cause headaches, drowsiness, dizziness, excitation, excessive salvation, vomiting and unconsciousness. Larger amounts may cause unconsciousness and death due to asphyxia.

The explosive potential for hydrogen is high. It has a low ignition energy and will readily ignite from any source of ignition, including static electricity and friction from escaping gas. Explosive mixtures are formed with air, oxygen and chlorine. A fireball is formed if gas cloud is ignited immediately after release. Vapors may travel to distant sources of ignition and flash back. Hydrogen flame may be pale or invisible.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible (2.1cc/100cc)
Solubility in Other Chemicals: Slightly soluble in ethanol and ether.
Specific Gravity: .071
Vapor Density (Air=1): .0696
Boiling Point: -252.8°C (423°F)
Melting Point: -259.2°C (-434.6°F)
Freezing Point: See melting point.
Molecular Weight: 2.016
Heat of Combustion: 121 kJ/g
Vapor Pressure: High
Flash Point: Burns at all ambient temperatures.
Autoignition Temperature: 571.2°C (1060°F); 500°C (932°F); 520°C (752°F); also reported 400°C (968°F)
Burning Rate: Rapid
Flammable Limits: 4.1% (LEL) - 74.2% (UEL)
Stability: Stable. Avoid sparks or flame source that can cause ignition.
Polymerization Potential: Will not occur.
Corrosiveness: Not corrosive to metals.
Reactivity and Incompatibility: Incompatible with air, oxygen, oxidizing agents, lithium, halides, alkali metals, metal catalysts, nitrogen trifluoride, oxygen difluoride, and halogens.

IDENTIFICATION

Shipping Name(s): Hydrogen, compressed (USDOT & IMO); Hydrogen, refrigerated liquid (USDOT & IMO)
Synonyms and Tradenames: None
CAS Registry No: 1333-74-0
Chemical Formula: H_2
Constituent Components (% each): Essentially 100% Hydrogen, although may contain trace amounts of helium and hydrocarbon gas such as methane.
UN/NA Designation: UN1049 (compressed); UN1966 (refrigerated liquid)
IMO Designation: 2.1
RTECS Number: MW8900000
NFPA 704 Hazard Rating (Gas): 0-gas, 3-liquid (Health): 4 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Compressed gas; liquid.
Physical Form as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless
Reportable Quantity: See appendix I
Common Uses: Used in the hydrogenation of vegetable and animal oils and fats, prevention of oxidation of metals, welding and cutting, petroleum refining, production of ammonia, methanol, aniline and some inorganic acids, fuel, propellant for nuclear powered rockets and space vehicles, etc.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

*

HYDROGEN (Refrigerated liquid or Compressed)

Division 2.1 (Flammable Gas)

*Also 1049

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Highly flammable with broad range of ignition with air. Liquid form of hydrogen can cause frost like burns. Inhalation of large concentration of gas may cause unconsciousness or death due to asphyxiation.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable (Simple asphyxiant)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as air, oxygen, oxidizing agents, lithium, halides, alkali metals, metal catalysts, nitrogen trifluoride, oxygen difluoride, and halogens.

HEALTH HAZARDS

Potential Health Hazards: Hydrogen has practically no toxicity except that it may asphyxiate and cause frost like burns with skin or eye contact.

Hazards of Skin or Eye Contact: Eye or skin contact with liquid can cause frost bite type injury due to rapid cooling from evaporation.

Hazards of Inhalation: In confined areas, vapors can accumulate and cause unconsciousness and death due to displacement of oxygen (simple asphyxia). Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excessive salivation, vomiting and unconsciousness.

Hazards of Ingestion: Ingestion is unlikely due to physical properties of hydrogen. Contact with the extremely cold liquid would, at the very least, cause frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 4.1%

Upper Flammable Limit: 74.2%

Behavior in Fire: Hydrogen is flammable. It will readily ignite if exposed to sources of heat and flame. Vapors may be heavier than air when cold, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable. A hydrogen flame can be pale or invisible. Containers exposed to prolonged fire or heat may violently rupture.

Hazardous Decomposition Products: None.

EXPLOSION HAZARDS

Explosive Potential: High. Severe explosion hazard when exposed to heat, flame or oxidizers. Explosive when mixed with air, oxygen and chlorine. Escaping gas may ignite spontaneously due to friction. Hydrogen has a low ignition energy and broad range of ignition with air. Fireball is formed if gas cloud is ignited immediately after release. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged fire or heat may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Specialized high temperature protective clothing is recommended for working in close proximity to hydrogen fires. Full structural firefighting personal protective equipment may be used by firefighters in support roles or for protecting exposure in perimeter area. Positive-pressure, self-contained breathing apparatus is required.

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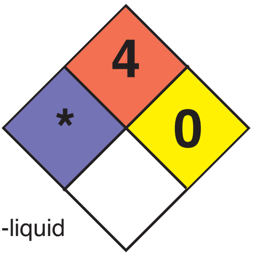
HYDROGEN (Refrigerated liquid or Compressed)

Division 2.1 (Flammable Gas)



*Also 1049

*0-gas; 3-liquid

FIRST AID

Nonspecific Symptoms: Hydrogen is relatively inert. Contact of liquid with skin or eyes may cause frost like burns. Inhalation is the major route of exposure and can cause headache, drowsiness, dizziness, excitation, excessive salivation, vomiting and unconsciousness. Higher levels may cause asphyxiation and death.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact with cold liquid, remove contaminated clothing and wash affected body areas with large amounts of warm water. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming such as wrapping effected area gently in blankets if warm water is not available. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Ingestion is unlikely. If liquid is ingested, frostbite like injury can occur. Drink warm water to relieve frostbite, but do not induce vomiting without medical supervision. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

FIRE RESPONSE

Extinguishing Agents: Stop flow. Carbon dioxide, dry chemical, water spray (fog), or foam. A fine water spray or fog can be used on large discharges to control the fire by preventing its spread and absorbing some of its heat. Do not apply water streams directly on a hydrogen pool fire since this may greatly and/or suddenly increase the rate of burning and/or the size of the fire by increasing the vaporization rate of the liquid.

Extinguishing Techniques: Stay upwind. Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid flammable vapors. Hydrogen fires burn at very high temperatures and are almost invisible, especially when wearing self contained breathing apparatus and a proximity hood. A broom should be held in front of advancing firefighters to locate the flame. Wear positive-pressure, self-contained breathing apparatus and appropriate protective clothing. Wear full chemical and/or thermal protective suit as necessary and appropriate. Move container from fire area if no risk. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to prolonged heat, such as from a direct flame. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable gases.

SPILL RESPONSES

General Information: Hydrogen is highly flammable. Eliminate all sources of ignition. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with very cold gas or liquid unless properly equipped for such contact. If transfer operations are anticipated, only use equipment specifically designed for use with the material being transferred and its temperature and pressure at the time of transfer. One method to dispose of excess or undesired hydrogen is to “flare” it under controlled conditions; consult qualified experts for advice on safe flaring techniques if this approach is considered. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows and depressions. Use combustible gas detectors prior to entering any potentially affected confined space or any low area in which cold, heavier-than-air gases or vapors may have accumulated (but keep in mind that the gas or vapor will become lighter than air as it warms and will disperse more easily). Do not direct water at a venting safety device since this may cause icing to occur. Note that the rapid escape of gas under pressure may generate a static electricity charge that could cause gas ignition. Be advised that the very low temperatures associated with hydrogen can cause many materials to become brittle and subject to sudden failure or cracking. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

MONITOR THE SITUATION . . . Hydrogen is expected to exist almost entirely in the vapor phase when released into the atmosphere. Depending on the magnitude of the release, flammable concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

HYDROGEN (Refrigerated liquid or Compressed)
Division 2.1 (Flammable Gas)

TECHNIQUE

FOAM . . . Foam can be applied in large volumes to the surface of confined pools of hydrogen to slow the rate of vapor evolution, particularly after boiling pools have quieted down.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression. Be advised of the possibility of a short-term increase in vapor evolution when the foam (which will be warmer than the hydrogen) is first applied.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to the soil, initially liquid will rapidly boil, generate a large amount of flammable vapors and freeze the ground it is in contact with. Much later, the liquid will reach a less rapid boiling rate thereby evolving less vapors. Containment dikes or barriers using soil, sand or other related materials may be effective to confine the spill to a limited area thereby reducing the surface area and volume of gas generated until liquid evaporates. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material.

CONSEQUENCE

Contained material will take longer to evaporate.

MITIGATION

Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater, which may overfill diked areas.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches. Generally practicable only for small leaks. Reducing the spill surface area will decrease the vapor generation.

CONSEQUENCE

Contained material will take longer to evaporate. Mechanical equipment could ignite material.

MITIGATION

Continually monitor for flammable conditions. Dig a deep pit with small area to reduce vapor generation rate. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill pits.

TECHNIQUE

MECHANICAL REMOVAL . . . Most if not all the hydrogen will rapidly vaporize from soil surfaces once the bulk of the hydrogen liquid has vaporized. Mechanical equipment can be used to grade frozen ground to eliminate any pockets of material.

CONSEQUENCE

Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Continually monitor for flammable conditions.

HYDROGEN (Refrigerated liquid or Compressed)
Division 2.1 (Flammable Gas)

TECHNIQUE

LET BURN . . . If pool not ignited or already ignited it may be safer to burn the hydrogen rather than attempt to recover it or put out fire.

CONSEQUENCE

If pool is not well confined, fire may spread and increase burn area. If large amount of liquid spilled, the time of burn may be too long.

MITIGATION

Ensure pool is well confined and unable to spread. Ensure area is well clear of any population that may be exposed to heat or material that could be ignited by intense heat. Consult qualified personnel regarding safety of flaring the gas.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake and monitor situation.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

MONITOR THE SITUATION . . . Hydrogen will vigorously and rapidly boil off the surface of water bodies.

CONSEQUENCE

Flammable concentrations will exist in the area before time and distance from the area of the spill has diluted the hydrogen gas.

MITIGATION

Evacuate area affected and continually monitor until conditions are safe.

March 1995

HYDROGEN BROMIDE

Poison Gas

(Division 2.3)

GENERAL INFORMATION

Hydrogen bromide is a toxic and corrosive but nonflammable colorless gas that has a sharp, pungent, irritating, acrid, and suffocating odor and that is shipped as a pale yellow liquid under pressure. It is used to make a variety of other chemicals including several pharmaceuticals. The liquid product is highly soluble in water and heavier, so may be expected to sink while simultaneously boiling, forming hydrobromic acid in water, and generating heat. All spills on water or land will result in the generation of relatively large quantities of heavier than air gas and fumes which may be dense and white in appearance at first and which may persist in pits, hollows, and depressions. Contact with most metals may liberate flammable and potentially explosive hydrogen gas in the presence of moisture. Containers may rupture violently due to overpresurization if exposed to fire or excessive heat for sufficient time duration. Liquid hydrogen bromide weighs between 17.9 and 23.1 pounds per gallon near its boiling point temperature according to various authorities.

Hydrogen bromide is stable in normal transportation, is highly corrosive to metals in the presence of moisture, and is reactive with a wide variety of other chemicals and substances. Both the liquid and its vapors and fumes are corrosive to bodily tissues and may rapidly cause severe irritation or burns. Exposure to very high temperatures may cause decomposition of hydrogen bromide into hydrogen and bromine according to one authority.

Downwind evacuation should be considered if hydrogen bromide is leaking until properly equipped responders have evaluated the hazard. Evacuation of a circular region may also be necessary if a container is exposed to direct flame or a fire becomes uncontrollable for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; 198g/100g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol and organic solvents

Specific Gravity (Liquid): 2.14–2.21 or 2.72–2.77 at boiling point; reported values vary.

Boiling Point: –88.2 to –87.5°F (–66.8 to –66.4°C) at 1 atm.

Melting Point: –124.6 to –122.8°F (-87 to -86°C)

Freezing Point: See melting point

Molecular Weight: 80.92

Heat of Combustion: Not flammable

Vapor Pressure: 22.8 atm (334.7 psia) at 70°F (21.1°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Essentially inert to common metals when dry under normal conditions but no galvanized metals or brass or bronze should be used at higher than atmospheric pressure. In presence of moisture will attack most metals except silver, platinum, and tantalum while liberating hydrogen gas according to one authority. Another states that copper-nickel alloys, copper-tin alloys, stainless steel and nickel-chromium alloys offer the best resistance to HBr corrosion with Kel-F and teflon best for gaskets and Buna S, Buna N, and neoprene being unacceptable.

Reactivity with Water: Dissolves with considerable evolution of heat to form hydrobromic acid.

Reactivity with Other Chemicals: Incompatible and may react violently with fluorine (flaming occurs), ammonia, possibly iron oxide, strong oxidizing agents, strong caustics, and unsaturated organic matter. Contact of dry hydrogen bromide with ozone may result in an instantaneous explosion. Contact with strong oxidants may liberate bromine gas.

IDENTIFICATION

Shipping Names: Hydrogen bromide, anhydrous (USDOT & IMO)

Synonyms and Tradenames: Anhydrous hydrobromic acid; anhydrous hydrogen bromide

Chemical Formula: HBr

Constituent Components (% each): 99.8% or more pure with remainder mostly hydrogen chloride

UN/NA Designation: UN1048

IMO Designation: 2.3, poison gas

Physical State as Shipped: Liquefied compressed gas

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Pale yellow liquid that fumes in moist air; colorless gas; white dense fumes.

Odor Characteristics: Pungent; irritating; acrid; sharp; suffocating.

Common Uses: Making of a variety of other chemicals including several pharmaceuticals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROGEN BROMIDE
Poison Gas
(Division 2.3)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at 2 ppm in air

Unusual Hazards: Evolves large amounts of heavier than air, corrosive and toxic gases and fumes upon release. May generate hydrogen gas in contact with metals in presence of moisture. Fumes and gases may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 3 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Excessive heat or fire, sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or waterbodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high gas and fume concentrations that may be present in air in the spill area and over considerable downwind distances. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid hydrogen bromide may result in severe tissue irritation, pain, swelling, tissue destruction, brownish-yellow stains, and deep slow healing burns. Severe exposures may result in shock. Contact with the eyes may cause extreme pain, tearing, irritation and swelling of the eyelids, corneal burns, and either temporary or permanent impairment or loss of vision. Do not wear contact lenses when working with this product. Note that the frostbite is also a possibility due to the very low boiling point of the product.

Hazards of Inhalation: Hydrogen bromide vapors and fumes are highly irritating to the eyes, nose, and upper respiratory tract. High concentrations in air may cause coughing, choking, headache, weakness, dizziness, difficult breathing, laryngeal spasm, tightness in chest, air hunger, frothy sputum, pulmonary edema (which may be delayed in onset), pneumonitis, and possibly death. Concentrations of 3-6 ppm cause nose and throat irritation in humans in several minutes. Exposure of rats to 2858 ppm in air for one hour was sufficient to kill 50% of the animals in laboratory experiments; 814 ppm had similar effects on mice. One authority reports that 1300-2000 ppm would be lethal to humans in a few minutes.

Hazards of Ingestion: Although ingestion of anhydrous hydrogen bromide is unlikely, ingestion of the product or concentrated hydrobromic acid may result in burns of the mouth, throat, and stomach. Similar acids also cause pain, nausea, vomiting, and possibly death due to esophageal or gastric necrosis.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Containers may rupture violently in fire due to over-pressurization. Will generate large quantities of corrosive gas or fumes upon release.

Hazardous Combustion Products: Not flammable but may decompose to hydrogen and bromine at very high temperatures.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

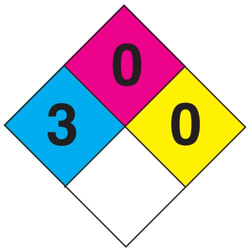
Upper Explosive Limit (UEL): Not flammable

Explosiveness: Containers may rupture violently in fire due to over-pressurization. Contact with most metals in presence of moisture liberates hydrogen gas that may explode if ignited in a confined space. Contact with ozone may result in instantaneous explosion.

1048

HYDROGEN BROMIDE

Poison Gas
(Division 2.3)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid gas canister (50 ppm or less) or a chemical cartridge respirator with an acid gas cartridge and full facepiece (50 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; coughing, choking, or other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but note that contact of water with pools of liquid hydrogen bromide may result in increased vapor evolution.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay up wind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account when planning the response that hydrogen bromide is a corrosive and highly volatile substance. Contact with metals in the presence of moisture may generate hydrogen gas and require use of explosion-proof and spark-proof tools and equipment. Mixtures with water produce hydrobromic acid. Accumulations of heavy gas may persist in pits, hollows, and depressions.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrogen bromide spills may expose downwind areas to toxic concentrations over considerable distances if large quantities of corrosive fumes or gases are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HYDROGEN BROMIDE
Poison Gas (Division 2.3)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to hydrogen bromide vapors or fumes may absorb vapors, knock down fumes, and accelerate their dispersal in the atmosphere. Apply water at a point down wind and do not allow it to contact pools of liquid hydrogen bromide as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain hydrobromic acid from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as firehose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION ... The rapid addition of flooding quantities of water to liquid hydrogen bromide may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent to liquid hydrogen bromide may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid hydrogen bromide may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained hydrogen bromide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

HYDROGEN BROMIDE
Poison Gas (Division 2.3)

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. high pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Although a large fraction of the hydrogen bromide may boil and vaporize, significant amounts may dissolve in water.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

HYDROGEN CHLORIDE
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Hydrogen chloride is a highly toxic and corrosive nonflammable colorless gas that has a sharp, pungent, irritating odor and is shipped as a liquid under pressure. It is used to make drugs, food starch, and other chemicals, and is also used in ore refining, scale removal, and rubber processing. The liquid is substantially soluble in water and somewhat heavier, and may be expected to sink and moderately react with water (to produce hydrochloric acid and heat) while simultaneously boiling. All spills on water or land will result in the generation of relatively large quantities of heavier than air gas and fumes that may be toxic over considerable downwind distances and may persist in pits, hollows, and depressions. Contact with most metals in the presence of moisture may evolve flammable and potentially explosive hydrogen gas. Containers of hydrogen chloride may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. Liquid hydrogen chloride weighs approximately 9.9 pounds per gallon near its boiling point temperature.

Hydrogen chloride is stable in normal transportation. It is highly corrosive to metals, particularly in the presence of moisture, and is reactive with a wide variety of other chemicals. The heat generated in reaction with any alkali or active metal may be sufficient to ignite adjacent combustible materials. Both liquid and gaseous hydrogen chloride are highly corrosive to bodily tissues and may rapidly cause inflammation or burns.

If bulk container is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of 2500 feet. If cylinder is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of 1500 feet. If hydrogen chloride is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 62 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, benzene and ether.

Specific Gravity (Liquid): 1.19 at – 121°F (– 85°C)

Boiling Point: – 121°F (– 85°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: – 175°F (– 115°C)

Molecular Weight: 36.46

Heat of Combustion: Not flammable

Vapor Pressure: 40 atm (587.6 psia) at 64°F (17.8°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Corrosive to most metals with evolution of hydrogen gas, particularly in the presence of moisture, but not corrosive to steel when dry.

Reactivity with Water: Moderate reaction with evolution of heat.

Reactivity with Other Chemicals: Reacts with most metals; alkali or active metals and certain of their compounds; acetic anhydride; 2-amino ethanol; ammonium hydroxide; chlorosulfonic acid; oleum; sulfuric acid; ethylene diamine or imine; propylene oxide; vinyl acetate; B-propiolactone; $HC1O_4$; and a variety of other chemicals.

IDENTIFICATION

Shipping Names: Hydrogen chloride, anhydrous (USDOT, IMO); hydrogen chloride, refrigerated liquid (USDOT).

Synonyms and Tradenames:Hydrochloric acid, anhydrous; anhydrous hydrochloric acid; hydrochloric acid gas; hydrochloride; basilin; chlorohydric acid.

Chemical Formula: HC1

Constituent Components(% each): 97.5-99% pure (technical grade)

UN/NA Designation: UN1050; UN2186 (refrigerated liquid)

IMO Designation: 2.2 nonflammable gas

Physical State as Shipped: Compressed liquefied gas

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless to slightly yellow

Odor Characteristics: Sharp, pungent, irritating

Common Uses: Mfg. of pharmaceuticals and other chemicals; chlorination of rubber; laboratory reagent; hydrolyzing food starch; ore refining; scale remover and cleaner.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

HYDROGEN CHLORIDE

Poison Gas

(Division 2.3)

See "UN/NA Designation" for
other ID numbers

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1-5 ppm

Unusual Hazards: Evolves large amounts of heavier than air, corrosive and toxic fumes and gases upon release. May generate hydrogen gas upon contact with metals. Heat of reaction with any alkali or active metal may ignite nearby combustible material. Fumes and gases may persist in pits, hollows, and depressions.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 5 ppm absolute ceiling limit.(ACGIH)

Conditions to Avoid: Excessive heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to high gas or fume concentrations in air but all exposures should be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid hydrogen chloride or concentrated gas may rapidly result in inflammation or burns. Contact with the eyes may cause irritation, severe burns, and permanent damage with possible loss of sight. Frostbite is also possible.

Hazards of Inhalation: Hydrogen chloride gas or fumes may cause irritation of the respiratory tract with burning, choking, and coughing. High concentrations in air may result in ulceration of the nose and throat, severe delayed breathing difficulties involving pulmonary edema, laryngeal edema or spasm, and possibly death. Concentrations of 1000-2000 ppm may be dangerous even for brief exposures.

Hazards of Ingestion: Ingestion of hydrogen chloride or concentrated acid solutions may result in burns of the mouth, throat and stomach, pain, nausea, vomiting, and possibly death due to esphageal or gastric necrosis.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit:: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. Will generate large quantities of corrosive gas or fumes upon release.

Hazardous Combustion Products: Not flammable

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Cylinders may rupture violently in fire due to overpressurization. Contact with most metals produces hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

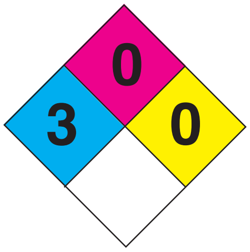
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl chloride, Viton, and Saranex.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid gas canister (100 ppm or less) or an acid gas cartridge respirator with a full facepiece (100 ppm or less) within the use limitations of these devices.

1050

See "UN/NA Designation" for
other ID numbers

HYDROGEN CHLORIDE
Poison Gas
(Division 2.3)



FIRST AID

Nonspecific symptoms: Irritation or burns of any bodily tissues; choking, coughing and other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but be cautious in applying water to spilled product.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts moderately with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers or confined spaces. Protect sewers and water-ways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or other-wise damaged by the spilled product. Take into account while planning the response that hydrogen chloride is a corrosive and extremely volatile substance; also, that contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Note that contact with water produces hydrochloric acid. Accumulations of heavy gas may persist in pits, hollows, or depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrogen chloride spills may expose downwind areas to toxic concentrations over considerable distances if large quantities of corrosive fumes or gases are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HYDROGEN CHLORIDE
Poison Gas (Division 2.3)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrogen chloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not let it contact pools of liquid hydrogen chloride as this may increase fume evolution in some cases.

CONSEQUENCE

Water runoff may contain hydrogen chloride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid hydrogen chloride may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid hydrogen chloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hydrogen chloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained hydrogen chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

HYDROGEN CHLORIDE
Poison Gas (Division 2.3)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vaculm trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply technique to remove final traces of spilled product or to remove products of neutralization.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

HYDROGEN CHLORIDE
Poison Gas (Division 2.3)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

HYDROGEN FLUORIDE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Hydrogen fluoride is an extremely volatile, nonflammable and colorless corrosive liquid that boils at the relatively low temperature of 67°F and has a pungent irritating odor. It is used for a variety of purposes including polishing, etching, and frosting of glass; pickling brass, copper, and steels; electropolishing of metals; cleaning castings; dissolving ores; and making fluorinated chemicals. The liquid dissolves in water with substantial generation of heat to form extremely corrosive hydrofluoric acid. Although hydrogen fluoride is not itself flammable, contact with some metals may evolve flammable and potentially explosive hydrogen gas. Containers of liquid may rupture if exposed to excessive heat or fire for sufficient time duration due to overpressurization. The product's boiling point of about 67°F and its considerable vapor pressure indicate that it will boil in warm weather and will otherwise evaporate rapidly to produce large amounts of gases, vapors, and white fumes that may be hazardous over considerable downwind distances. The liquid weighs approximately 8.3 pounds per gallon.

Hydrogen fluoride is highly reactive with a variety of chemicals and is corrosive to natural rubber, leather, many organic materials, glass, concrete, and certain metals, especially those like cast iron that contain silica. It is also highly corrosive in all forms to bodily tissues and may cause severe and painful burns.

Downwind evacuation should be considered if hydrogen fluoride is leaking. A distance of up to one-half (1/2) mile should be considered depending on the amount of material spilled, location, and local weather conditions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol
Specific Gravity (Liquid): 0.992 at 66.2°F (19°C)
Boiling Point: 67.1°F (19.5°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –134°F (– 92.2°C)
Molecular Weight: 20.01
Heat of Combustion Not flammable
Vapor Pressure: 760 mm Hg (14.7 psia) at 67.1°F (19.5°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: Will attack natural rubber, leather, many organic materials, glass, concrete, and certain metals, especially those like cast iron that contain silica. Lead, wax, polyethylene and platinum are not corroded.
Reactivity with Water: Dissolves with liberation of heat.
Reactivity with Other Chemicals: Reacts with arsenic trioxide, phosphorus pentoxide, bismuthic acid, nitric acid, fluorine, sodium, cyanides, sulfides, acetic anhydride, 2-amino ethanol, ammonium or sodium hydroxide, calcium oxide, chlorosulfonic acid, ethylene diamine or imine, oleum, B-propiolactone, propylene oxide, sulfuric acid, vinyl acetate, and a variety of other chemicals.

IDENTIFICATION

Shipping Names:: Hydrogen fluoride, anhydrous (USDOT and IMO).
Synonyms and Tradenames: Hydrofluoric acid, anhydrous; anhydrous hydrofluoric acid; fluorohydric acid gas; HF; AHF; HF-A
Chemical Formula: HF
Constituent Components(% each): 99-99.97% pure
UN/NA Designation: UN1052, UN1790
IMO Designation: 8, corrosive material
Physical State as Shipped: Liquid
Physical State as Released: Liquid or gas (boiling point is 67.1°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent, irritating
Common Uses: Polishing, etching and frosting glass; pickling copper, brass, stainless and other alloy steels; electropolishing metals; cleaning castings; dissolving ores; acidizing oil wells; making fluorinated chemicals; laundry sour.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROGEN FLUORIDE

Class 8 (Corrosive Material)

and

See "UN/NA Designation" for other ID numbers

and

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Extremely volatile and corrosive substance. Contact with some metals may produce flammable hydrogen gas. May be toxic in air over considerable downwind distances.

Short Term Exposure Limits (STEL): 6 ppm as Fluorine for 15 minutes.(ACGIH)

Time Weighted Average (TLV-TWA): 3 ppm as Fluorine over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Excessive heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Hydrogen fluoride is extremely dangerous by all possible routes of exposure. Toxic concentrations may exist over considerable downwind distances in air.

Hazards of Skin or Eye Contact: Contact with liquid hydrogen fluoride, its water solutions, or high vapor concentrations in air may result in severe burns involving localized death of skin and deep tissue and possible decalcification of bone. These effects may be delayed 1-8 hours if solutions are less than 50% hydrogen fluoride. Contact with the eyes may cause severe irritation and deep-seated burns possibly resulting in blindness or other permanent defects in vision.

Hazards of Inhalation: Hydrogen fluoride is a severe respiratory irritant which may cause burns of the nose, throat and upper respiratory tract, nasal congestion, and bronchitis. High concentrations in air may cause rapid inflammation and congestion of the lungs as well as severe breathing difficulties that may result in death from pulmonary edema. Severe effects may be delayed some hours after the exposure has ceased. Concentrations of only 50-250 ppm are considered dangerous for even brief exposures.

Hazards of Ingestion: Ingestion may result in severe damage to the mouth, throat and stomach. Effects may include nausea, vomiting, pain, and diarrhea.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. Will generate large quantities of corrosive gas or fumes upon release.

Hazardous Combustion Products: Not flammable

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may rupture violently in fire due to overpressurization. Contact with metals may produce hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

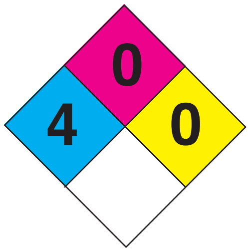
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene, nitrile rubber, Viton, and nitrile butadiene rubber based on data for 30-70% solutions in water.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 20 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted hydrogen fluoride canister and filter or a hydrogen fluoride cartridge respirator with a full facepiece within the use limitations of these devices.

1052

See "UN/NA Designation" for
other ID numbers

HYDROGEN FLUORIDE
Class 8 (Corrosive Material)



FIRST AID

Nonspecific symptoms: Irritation or burns of any bodily tissues; choking, coughing and other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide or water spray, but be cautious in applying water to pools of spilled product.

Extinguishing Techniques: Corrosive vapor or fume hazard. Dissolves in water with heat evolution. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers or confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that hydrogen fluoride is a corrosive and extremely volatile substance; also, that contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Note that contact with water produces hydrofluoric acid.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrogen fluoride spills may expose downwind areas to toxic concentrations over considerable distances if large quantities of corrosive fumes or gases are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

HYDROGEN FLUORIDE
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrogen fluoride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not let it contact pools of liquid hydrogen fluoride if any increase in fume evolution is observed.

CONSEQUENCE

Water runoff may contain hydrogen fluoride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid hydrogen fluoride may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid hydrogen fluoride may eventually slow the release of vapors or fumes into the atmosphere. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Hydrogen fluoride may be contained by building dikes using soil or other compatible substances.

CONSEQUENCE

Contained hydrogen fluoride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

HYDROGEN FLUORIDE

Class 8 (Corrosive Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply technique to remove final traces of spilled product or to remove products of neutralization.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

HYDROGEN FLUORIDE

Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Do not use caustic soda-sodium hydroxide.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2003

HYDROGEN PEROXIDE
Division 5.1 (Oxidizer)

GENERAL INFORMATION

Hydrogen peroxide is a colorless liquid that may be shipped as a relatively pure product or as various strength solutions in water. This guide is primarily intended for the relatively pure product. Although hazards of aqueous solutions may be less severe and physical properties may differ, much of the information here is generally applicable to such solutions if properly interpreted. Hydrogen peroxide is fully soluble in water and has a slightly sharp and irritating odor. It is used as a rocket propellant, a bleaching or disinfecting agent and as an ingredient or raw material for various chemicals and products. Although it is not itself flammable, it is a strong oxidizer and may cause fire, violent reactions and possibly explosions upon contact with combustible materials or certain metals. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration, or if contaminated with certain metals or dirt. The product weighs approximately 12 pounds per gallon.

Hydrogen peroxide does not react with water and is quite stable if uncontaminated. It is reactive with various chemicals and ordinary combustibles and may attack or ignite some forms of plastics, rubber or coatings. The concentrated product is irritating and injurious to bodily tissues by all routes of potential exposure. Products of decomposition are oxygen and water.

Initial downwind evacuation should be considered for at least 100 meters (330 feet) in all directions if hydrogen peroxide is leaking but not on fire. If the material is in a mixed load shipment (small packages shipped with other small packages in the same outer packaging, railcar, container or trailer) and exposed to fire or direct flame, evacuate for one-half (1/2) mile in all directions. If bulk container is exposed to direct flame or fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in diethyl ether and ethyl alcohol.

Specific Gravity (Liquid): 1.407 at 77°F (25°C)

Vapor Density: 1.1

Boiling Point: Variable depending on concentration. Ranges from 223°F (106°C) to 302.4°F (150.2°C) (decomposes)

Melting Point: Variable depending on concentration. Ranges from -18°F (-27°C) to 31.3°F (–0.4°C)

Freezing Point: See melting point.

Molecular Weight: 34.01

Vapor Pressure: 1 mm Hg (0.019 psia) at 59.5°F (15.3°C)

Evaporation Rate (butyl acetate=1): >1

pH: Reported values range from less than 3 to 4.

Heat of Combustion: Not flammable

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Pure grades are quite stable, but contamination by metals or dirt or excessive heat can cause rapid or violent decomposition.

Polymerization Potential: Will not occur. However, will catalyze polymerization.

Corrosiveness: Relatively noncorrosive but may react with certain metals (see below) or attack or react with some plastics, rubber or coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Strong oxidizer. Reacts with most organic or readily oxidizable materials, chemicals, or combustibles; iron, copper, brass, bronze, magnesium, chromium, zinc, lead, manganese, silver, platinum, or other catalytic metals or their salts; glycerin, hydrazines, alcohol, oxides and a variety of other substances.

IDENTIFICATION

Shipping Name(s): Hydrogen peroxide, stabilized or hydrogen peroxide, aqueous solutions (UN2015) (USDOT & IMO); Hydrogen peroxide, aqueous solutions (UN2014 &UN2984) (USDOT & IMO)

Synonyms and Tradenames: Hydrogen dioxide; Peroxide; Hydroperoxide; Perhydrol; Dihydrogen dioxide; Hydrogen oxide; Inhibine; Peroxan; Superoxol; T-stuff; Albone; Hioxy.

CAS Registry No.: 7722-84-1

Chemical Formula: $H_2 0_2$

Constituent Components (% each): 3% to almost 100% pure with remainder being water. May contain small amount of stabilizer.

UN/NA Designation: UN2015 (>60%); UN2014 (>20% to 60%); UN2984 (20% to >8%)

IMO Designation: 5.1, Oxidizing substances

RTECS Number: MX0900000 or MX0899000

NFPA 704 Hazard Rating: 2 (Health): 0 (Flammability): 1 (Reactivity): Oxidizing Agent

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Slightly sharp, irritating

Common Uses: Rocket propellant; bleaching agent; disinfectant; mfg. chemicals, buttons, pharmaceuticals, felt hats, plastic foam, sponge rubber, pesticides and dyes; used to artificially age wines and liquors; gasoline additives, plasticizers, dyestuffs, textile finishing agents, germicides, medicinal products and other chemicals and products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

*

HYDROGEN PEROXIDE

Division 5.1 (Oxidizer)

*Also 2014 and 2984

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: May ignite, react violently or even cause explosion of combustible or organic materials upon contact when concentrated. Containers may rupture violently due to rapid product decomposition if heated or contaminated by metals or dirt.

Short Term Exposure Limit (STEL): 2 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 1 ppm (1.4 mg/m^3)

IDLH: 75 ppm (solutions with higher concentrations)

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from breathing high concentrations in the immediate spill area and directly downwind. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid hydrogen peroxide may cause tingling and temporary whitening if the skin is washed promptly. If not removed, redness and blisters may occur. Contact with the eyes may cause severe damage and possible blindness. Damage may appear a week or more after exposure.

Hazards of Inhalation: Vapors of hydrogen peroxide may cause extreme irritation of the eyes, nose and throat. Pulmonary irritation ranging from mild bronchitis to pulmonary edema is also possible. One authority reports the irritation threshold to be 100 ppm in air, presumably in acute exposures.

Hazards of Ingestion: Ingestion may result in injury to the mouth and throat with possible bleeding of the esophagus and stomach. The product may also produce oxygen gas that may distend the esophagus and stomach and possibly cause severe damage.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may explode or rupture violently in fire due to overpressurization.

Hazardous Combustion Products: Decomposition products are water, oxygen, hydrogen gas, heat and steam but any unburned product may be hazardous. Release of oxygen may support combustion.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire due to overpressurization. Contact with combustible materials or some metals may result in formation of explosive mixtures in some cases when the product is concentrated.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with vapor or fume concentrations in air above 75 ppm. Compatible materials may include butyl rubber, neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, polyurethane, polyvinyl chloride, styrene-butadiene rubber, Viton®, natural rubber or polyethylene for 70% or less solutions.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2015 *

*Also 2014 and 2984

HYDROGEN PEROXIDE

Division 5.1 (Oxidizer)

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, skin or other tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if skin irritation persists.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not induce vomiting. Get medical attention immediately. Gastric lavage may be necessary if swallowed.

FIRE RESPONSE

Extinguishing Agents: Use water in ample quantities or appropriate foam. Do not use CO_2, dry chemical or organic material.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with concentrated material or dense fumes/smoke anticipated. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or rupture of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that concentrated hydrogen peroxide is a strong oxidizer that may ignite or otherwise react violently with a wide variety of materials. Decomposition produces pure oxygen. High pressures may develop in unvented containers.

HYDROGEN PEROXIDE
Division 5.1 (Oxidizer)

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Hydrogen peroxide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrogen peroxide vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of material from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to hydrogen peroxide may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

HYDROGEN PEROXIDE

Division 5.1 (Oxidizer)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Hydrogen peroxide may be confined by building dikes using soil, sand or other non-combustible materials.

CONSEQUENCE

Confined liquid may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

HYDROGEN PEROXIDE
Division 5.1 (Oxidizer)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels. (There is a possibility that hydrogen peroxide may be held in a diked area until peroxide completely decomposes. Consult with qualified experts on this subject.)

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

HYDROGEN SELENIDE
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Hydrogen selenide is a compressed or liquefied compressed poison gas with an offensive disagreeable odor resembling decayed horseradish. It is used for making selenium compounds and electronic semiconductors. The liquid is heavier than water and slightly soluble so may be expected to sink while boiling rapidly and dissolving slowly. The gas is heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, or depressions. Accumulations of gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 17.1 pounds per gallon at its boiling point temperature.

Hydrogen selenide is stable in normal transportation but may decompose in air to form red selenium precipitate. It does not react with water or many other common materials, but may react vigorously, ignite, or explode in contact with strong oxidizing agents, alkalies, or halogenated hydrocarbons. Toxicity of the product is extremely high via inhalation. Products of combustion include toxic selenium dioxide fumes.

Downwind evacuation should be considered if hydrogen selenide is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 270 ml gas/100 ml water at 72.5°F (22.5°C); 0.73 g/100 g water at 68°F (20°C).

Solubility in Other Chemicals: Soluble in carbonyl chloride, carbondisulfide, and phosgene.

Specific Gravity (Liquid): 2.0–2.1 at boiling point

Boiling Point: – 44 to – 42°F (–42.2 to –41.1°C) at 1 atm.

Melting point: – 86.3 or – 83.2°F (– 65.7 or – 64°C); reported values vary.

Freezing point: See melting point

Molecular Weight: 80.98

Heat of combustion: Unavailable

Vapor Pressure: 9.5 atm (139.56 psia) at 70°F (21.1°C)

Flash Point: Flammable gas

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable in normal transportation; decomposes in air to form red selenium precipitate.

Corrosiveness: Aluminum and stainless steel most resistant. Iron, steel or brass acceptable under many conditions. Unites directly with many metals to form metallic selenides.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Various authorities indicate the possibility of vigorous reaction, fire, and/or explosion upon contact with strong oxidizing agents, alkalies, or halogenated hydrocarbons.

IDENTIFICATION

Shipping Names: Hydrogen selenide, anhydrous (USDOT and IMO)

Synonyms and Tradenames: Selenium hydride; dihydrogen selenide; selenium dihydride; selane; selenium anhydride.

Chemical Formula: H_2Se

Constituent Components (% each): 98% or more pure

UN/NA Designation: UN2202

IMO Designation: 2.3, poison gas

Physical State as Shipped: Compressed or liquefied compressed gas.

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Disagreeable; offensive; like decayed horseradish

Common Uses: Making metallic selenides and organoselenium compounds; in doping gas for making electronic semiconductor materials.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROGEN SELENIDE

Poison Gas (Division 2.3)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at 0.3 ppm but deadens sense of smell rapidly at levels below 1 ppm.

Unusual Hazards: Extremely toxic and flammable compressed or liquefied compressed gas. Vapors are heavier than air and may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.05 ppm as Se over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact with cold liquid, gas, or containers.

HEALTH HAZARDS

Public Health Hazards: Major hazard by far is from inhalation of the high vapor concentrations that may be present in air in the spill area and over considerable downwind distances. Note that hydrogen selenide may deaden the sense of smell and is reported to be an allergen by some authorities. Direct contact and ingestion should also be strictly avoided.

Hazards of Skin or Eye Contact: The hazards of skin or eye contact with liquid hydrogen selenide or its concentrated vapors are not well defined. Various authorities suggest the possibility of irritation, chemical burns, and burns due to frostbite.

Hazards of Inhalation: Vapors of hydrogen selenide are extremely irritating to the eyes, nose, throat, and lungs and are considered intolerable at a level of 1.5 ppm in air. Severe (acute) exposures may result in coughing, nasal secretions, chest pain, dizziness, nausea, vomiting, difficult breathing, cyanosis, pulmonary edema (which may be delayed in onset), bronchitis, liver and spleen injury, pneumonitis, and possibly death. Prolonged exposures may also cause metallic taste in mouth, garlic odor on breath, and extreme fatigue. Other possible symptoms include a possible hemolytic effect, occasional hyperglycemia, and gastrointestinal distress. Note that hydrogen selenide is easily oxidized to red selenium on the surface of membranes of the nose and lungs. Exposure to 0.3 ppm in air for 8 hours was fatal to guinea pigs (after a month) in laboratory experiments. Exposure to 6 ppm for 30 minutes caused deaths as did exposure to 10 ppm for 2 hours and about 85 ppm for 10 minutes.

Hazards of Ingestion: Due to its low boiling point, ingestion of hydrogen selenide is not considered likely and is not discussed in the literature.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable compressed or liquefied compressed gas. Containers may rupture violently in fire. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Burns with blue flame.

Hazardous Combustion Products: Toxic selenium dioxide fumes are produced in fires. Thermal decomposition produces elemental selenium.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with liquid hydrogen selenide, cold gas streams, or very cold containers of this product. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 0.05 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2202

HYDROGEN SELENIDE

Poison Gas (Division 2.3)

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas (including mucous membranes of nose if necessary) with large amounts of water. Get medical attention as necessary. Do not use hot water on frozen tissues or rub them if frostbite has occurred.

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or else let fire burn out while cooling surroundings with water spray or fog. Carbon dioxide may be used for extinguishment when reignition is no longer a possibility.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the extremely toxic, volatile, and flammable nature of hydrogen selenide into account when planning the response. Electrically ground and bond all lines and equipment as necessary to prevent sparks.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrogen selenide discharges may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to hydrogen selenide vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid hydrogen selenide as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of hydrogen selenide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

HYDROGEN SELENIDE
Poison Gas (Division 2.3)

TECHNIQUE

FOAM ...There is a possibility that application of an appropriate firefighting foam to the surface of liquid pools may slow the release of hydrogen selenide vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid hydrogen selenide may be contained by building dikes or barriers using soil, sand or other materials.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with the spilled product and of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable gases or vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

HYDROGEN SELENIDE
Poison Gas (Division 2.3)

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Liquid hydrogen selenide will boil rapidly while sinking in water. Only a small fraction may dissolve in water.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

HYDROGEN SULFIDE
Poison Gas
(Class 2.3)

GENERAL INFORMATION

Hydrogen sulfide is a colorless and poison liquefied compressed gas with a characteristic rotten eggs odor that may rapidly deaden the sense of smell. It has a variety of uses in making other chemicals and in metallurgy, laboratory analysis, and disinfection of agricultural products. Only slightly soluble in water and lighter, and having a very low boiling point, liquid hydrogen sulfide will rapidly boil from the surface of a water body with little dissolution (but even small amounts in water can be harmful to aquatic organisms). Rapidly vaporizing upon any release to the environment, and being heavier than air, its vapors may travel a considerable distance to a source of ignition and flash back, and may also persist in pits, hollows or depressions. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8 pounds per gallon near its boiling point temperature.

Hydrogen sulfide does not react with water and is stable in normal transportation. It is dangerously reactive with a variety of other chemicals, particularly with strong oxidizing agents, however, and attacks various metals and certain forms of plastics, rubber, and coatings. Toxicity of the product is especially high via inhalation and the liquid may cause frostbite as well as inflammation in contact with the skin or eyes. Products of combustion are also highly toxic and include oxides of sulfur.

If hydrogen sulfide is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half ($^{1}/_{2}$) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; approx. 1 g in 242 ml water at 68°F (20°C).

Solubility in Other Chemicals: Somewhat soluble in alcohol, ether, and glycerol.

Specific Gravity (Liquid): 0.95-0.96 at boiling point

Boiling Point: –77.3 to -76.4°F (–60.7 to –60.2°C) at 1 atm.

Melting Point: –122.1 to –118.8°F (–85.6 to –83.8°C)

Freezing Point: See melting point

Molecular Weight: 34.08

Heat of Combustion: –3640 cal/g

Vapor Pressure: 18.15 atm (266.7 psia) at 70°F (21.1°C)

Flash Point: Flammable gas

Autoignition Temperature: Most authorities give 500°F (260°C) but 554°F (290°C) also reported.

Burning Rate: 2.3 mm/minute (liquid)

Stability: Stable

IDENTIFICATION

Shipping Names: Hydrogen sulfide (USDOT); hydrogen sulphide (IMO)

Synonyms and Tradenames: Dihydrogen sulfide; dihydrogen monosulfide; sulfur hydride; sulfuretted hydrogen; hydrosulfuric acid; sewer gas; stink damp.

Chemical Formula: H_2S

Constituent Components (% each): 98.5% or more pure

UN/NA Designation: UN1053

IMO Designation: 2.3, poison gas

Corrosiveness: Attacks many metals to form sulfides and may corrode many metals rapidly when wet. May attack some forms of plastics, rubber, and coatings. Aluminum and 316 stainless among others are acceptable for wet or dry service. Black iron, carbon steel, and brass among others are acceptable for dry product. Avoid hard steels that are highly stressed and which may be subject to hydrogen embrittlement from hydrogen sulfide.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Highly reactive (possibly causing fire or explosions) with acetaldehyde, barium oxide and mercurous or nickel oxide, bromide pentafluoride, chlorine monoxide, chlorine trifluoride, fluorine, lead dioxide, oxygen difluoride, nitrogen trichloride, nitrogen trifluoride, powdered copper, nitric acid, chromic anhydride, soda lime, sodium, sodium peroxide, nitrogen triiodide, phenyl diazonium chloride, and strong oxidizing agents.

Physical State as Shipped: Liquefied gas at 350-400 psi

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Like rotten eggs; offensive; may be odorless at poisonous concentrations.

Common Uses: Source of sulfur; purification of certain acids; laboratory reagent; making other chemicals; metal extraction from ores; agricultural disinfectant.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

HYDROGEN SULFIDE
Poison Gas (Class 2.3)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.13 ppm (but possibly less); faint but readily perceptible at 0.77 ppm.

Unusual Hazards: highly toxic, flammable, heavier than air liquefied compressed gas. May persist in pits, hollows, and depressions. Exposure to hydrogen sulfide gas can deaden the sense of smell such that dangerous concentrations are not noticed after initial exposure.

Short Term Exposure Limits (STEL): 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, ordirect physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high gas concentrations that may be present in air in the spill area and over considerable downwind distances. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid hydrogen sulfide may cause irritation, painful inflammation, and frostbite, with at least one authority describing the product as corrosive to bodily tissues. Similarly, contact with the eyes may at the very least cause painful irritation, watering, and inflammation. Contact lenses should not be worn when working with this chemical.

Hazards of Inhalation: Hydrogen sulfide gas is irritating to the eyes, nose, and throat with some eye effects possibly delayed. Depending on the duration of exposure, inhalation of low to moderate concentrations in air may result in sneezing, headache, dizziness, drowsiness, upset stomach, fatigue, irritability, confusion, excitement, cold sweat, staggering, bronchitis, pulmonary edema (which may be delayed in onset), and bronchial pneumonia. High concentrations may quickly cause unconsciousness, convulsions, and death due to respiratory paralysis. Note that the sense of smell will deaden rapidly upon exposure to hydrogen sulfide. Levels of 1000-2000 ppm in air are sufficient to cause coma and possible death after a single breath. Concentrations between 600 and 1000 ppm may be fatal after 30 minute exposures.

Hazards of Ingestion: Due to its low boiling point, ingestion of hydrogen sulfide is considered unlikely.

FIRE HAZARD

Lower Flammable Limit (LFL): 4.0 or 4.3%; reported values vary.

Upper Flammable Limit (UFL): 44, 45, or 46%; reported values vary.

Behavior in Fire: Flammable liquefied compressed gas. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flashback. Containers may rupture violently in fire. Burns in air with pale blue flame.

Hazardous Combustion Products: Highly toxic oxides of sulfur (primarily sulfur dioxide).

EXPLOSION HAZARD

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with other chemicals such as strong oxidizing agents or certain metal oxides may result in formation of explosive mixtures.

1053

HYDROGEN SULFIDE

Poison Gas (Class 2.3)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent the skin from becoming frozen from contact with liquid hydrogen sulfide, cold gas streams, or cold equipment containing this product. Equipment should also prevent any reasonable probability of eye contact with liquid hydrogen sulfide. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, neoprene, chlorinated polyethylene, polyvinyl chloride, and styrene- butadiene rubber

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, or throat; headache, dizziness, upset stomach, or other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if irritation persists after washing.

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or else let fire burn while cooling surrounding equipment with water. Carbon dioxide, dry chemical, or water spray may be used after possibility of reignition has been eliminated.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Electrically ground and bond all lines and equipment as appropriate. Take the highly volatile, toxic, and flammable nature of hydrogen sulfide into account when planning the response.

HYDROGEN SULFIDE
Poison Gas (Class 2.3)

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Hydrogen sulfide discharges may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to hydrogen sulfide vapors or fumes may accelerate their dispersal in the atmosphere. Do not allow water to contact standing pools of liquid hydrogen sulfide as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of hydrogen sulfide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Note that even low levels of hydrogen sulfide in water can be dangerous to aquatic organisms.

TECHNIQUE

FOAM ... There is a possibility that application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of hydrogen sulfide vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if initial increase in vapor evolution may affect downwind populations. Consult qualified experts for advice where necessary

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid hydrogen sulfide or contaminated runoff may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

HYDROGEN SULFIDE
Poison Gas (Class 2.3)

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

ABSORPTION ... Spreading of contaminated runoff may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances. (Note: This response only applies to contaminated water runoff.)

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. (Note: This response only applies to contaminated water runoff.)

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders,bulldozers, or draglines. (Note: Most residues will vaporize eventually or degrade to sulfur in the environment.)

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

HYDROGEN SULFIDE
Poison Gas (Class 2.3)

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Most hydrogen sulfide will quickly boil from the water surface. Dissolved oxygen will eventually convert any hydrogen sulfide that dissolves in water to elemental sulfur. However, even low concentrations of hydrogen sulfide can be rapidly toxic to aquatic organisms.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment orstorage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture some spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Anion exchangers may also be effective.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1996

HYDROQUINONE*

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Hydroquinone is an organic colorless to light tan to white solid, found in powder, crystal or liquid form. It is produced from the oxidation of aniline, the reduction of quinone, the hydroxylation of phenol with 70% hydrogen peroxide in the liquid phase with a soluble acid catalyst, or from the alkylation of benzene and cumene. Hydroquinone is used primarily in the manufacture of photographic chemicals such as reducers and developers, however it may also be used as a chemical intermediate for dyes, stabilizers in paints, varnishes, motor fuels and oils, a raw material to produce rubber anti-oxidants, and as a polymerization inhibitor.

Hydroquinone is irritating to the eyes and skin. It is a skin sensitizer and repeated or prolonged exposure may cause allergic rashes, discoloration of the skin, and eye corrosion and ulceration. The most common route of exposure is through skin contact. It is mildly toxic by skin absorption, inhalation and ingestion. May cause irritation of the mouth and throat, nausea and vomiting.

Although the fire potential for hydroquinone is low when exposed to sources of heat and flame, it can react with oxidizing materials. Under severe dusting conditions, the material may form explosive mixtures with air, and explode if ignited in enclosed areas. Polymerization will not occur. When heated to decomposition, the burning material may generate irritating and poisonous gases, such as carbon monoxide. Normal structural fire fighting protective clothing will provide only limited protection for releases where hydroquinone is present. Runoff may be toxic. Hydroquinone is moderately water soluble. This material is normally stable, however it is incompatible with materials such as strong oxidizers, alkalis, oxygen, and sodium hydroxide.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Moderate (7% @ 25°C [77°F]).
Solubility in Other Chemicals: Freely soluble in alcohol, acetone and ether; very soluble in carbon tetrachloride; slightly soluble in benzene.
Specific Gravity (Liquid): 1.3
Vapor Density (Air=1): 3.81
Boiling Point: 285°C (545°F)
Melting Point: 170°C (338°F)
Freezing Point: Unavailable.
Molecular Weight: 110.11
Heat of Combustion: Unavailable.
Vapor Pressure: 1 mm Hg at 132°C (270°F)
Flash Point: 165°C (329°F)
Autoignition Temperature: 516°C (960°F)
Flammable Limits: Not established.
Stability: Stable.
Polymerization Potential: Will not occur.
Evaporation Rate: 1 (Ether=1.0)
pH: 4.0-4.7 @ 5% aqueous solution
Reactivity and Incompatibility: Incompatible with strong oxidizers, alkalis, oxygen, and sodium hydroxide.
Other Characteristics: When heated to decomposition, material emits irritating and poisonous carbon monoxide.

IDENTIFICATION

Shipping Name(s): Hydroquinone (USDOT & IMO)
Synonyms and Tradenames: Quinol, Hydroquinol, Tecquinol, P-Benzendiol, Hydroxy Phenol, Benzohydroquinone, 1,4-Benzenediol, Dihydroxybenzene, 1,4-Dihydroxybenzene, 4-Hydroxyphenol, Beta-Quinol, Diak 5, Eldoquin, Eldopaque, HE 5, Benzoquinol, Alpha-Hydroquinone, Hydroquinole, NCI-C55834, P-Dioxobenzene, P-Hydroquinone, Phiaquin, and Tenox HQ. CAS Registry No: 123-31-9
Chemical Formula: $C_6H_4(OH)_2$
Molecular Formula: $C_6H_6O_2$
UN/NA Designation: UN2662
IMO Designation: 6.1
RTECS Number: NIOSH/MX3500000
OHMTADS Number: 7217252
NFPA 704 Hazard Rating: 2 (Health): 1 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid/powder/crystals
Physical Form as Released: Liquid/powder/crystals
Color of the Shipped Material: Colorless to light tan to white. Its solution becomes brown in air due to the effects of oxidation.
Odor Characteristics: Odorless; slight odor
Common Uses: Hydroquinone is used primarily in the manufacture of photographic chemicals such as reducers and developers, however it may also be used as a chemical intermediate for dyes, a stabilizer in paints, varnishes, motor fuels and oils, a raw material to produce rubber anti-oxidants, and as a polymerization inhibitor.

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*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

HYDROQUINONE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Material is irritating to the eyes and skin; prolonged exposure can cause skin and eye discoloration.

Time Weighted Average (TLV-TWA): 0.4 ppm

Short Term Exposure Limit (STEL): Not established.

IDLH: 44 ppm

Conditions to Avoid: Heat, sparks, flame, moisture, incompatible materials such as strong oxidizers, alkalis, oxygen, and sodium hydroxide. Material may not be stored near food stuffs.

HEALTH HAZARDS

Potential Health Effects: Hydroquinone is irritating to the eyes, skin and respiratory system. May be mildly toxic by skin absorption or ingestion. Prolonged exposures can cause discoloration of the skin and eyes, and eye corrosion or ulceration. May cause allergic skin rashes. Gross overexposure may cause red blood cell destruction with anemia and central nervous system depression. In some cases, gross overexposure may be fatal. Individuals with preexisting diseases of the cardiovascular system may have increased susceptibility to the toxicity of excessive exposures. Exposure to hydroquinone may induce methemoglobinemia.

Hazards of Skin and Eye Contact: Skin contact may cause skin irritation with rash, redness, itching, burning, swelling and dermatitis. Prolonged exposures may lead to skin sensitization with allergic rashes. Repeated or prolonged exposure may cause discoloration of the skin. Eye contact may cause irritation with tearing, pain or blurred vision. Prolonged contact may cause eye corrosion or ulceration. Potential effects from repeated and/or prolonged exposures to vapor, aerosol or dusts include changes in corneal curvature with eventual stigmatism.

Inhalation Hazards: Inhalation may cause central nervous system (CNS) effects such as nausea, headache, dizziness or general weakness. Irritation of the upper respiratory tract and wheezing may also occur.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by shortness of breath, cyanosis, headache, nausea, and vomiting.

FIRE HAZARDS

Lower Flammable Limit: Not established.

Upper Flammable Limit: Not established.

Behavior in Fire: Although it will not readily ignite, hydroquinone will burn if exposed to sources of heat and flame, and if it comes into contact with oxidizing materials. Dusts may form explosive mixtures with air in enclosed areas and ignite in the presence of sources of ignition, heat and flame.

Hazardous Decomposition Products: When heated to decomposition, toxic and irritating gases such as carbon monoxide may be liberated in fire situations.

EXPLOSION HAZARDS

Explosive Potential: Low, however dusts may explode in enclosed areas.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are natural rubber, nitrile rubber, polyvinyl chloride and neoprene. Structural firefighting protective clothing only provides a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits.

2662

HYDROQUINONE
Division 6.1 (Poisonous Materials)

FIRST AID

Nonspecific Symptoms: Direct skin contact can produce irritation, itching, inflammation, and rashes. Central nervous system (CNS) effects may include nausea, headache, dizziness confusion, fatigue, incoordination, or general weakness.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physicians: If ingested and conscious, administer a slurry of activated charcoal in water if not previously administered. Perform gastric lavage with water. DO NOT USE ALCOHOL for gastric lavage. The use of a stomach tube may be contraindicated if corrosion is evident. Administer milk, egg whites, or olive oil as demulcents. Maintain patient in recumbent position. Apply external heat to keep warm. Give fluids to restore electrolyte balance. Treat shock if indicated and give antibiotics as necessary.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray, or AFFF foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water spray to cool fire-exposed containers, disperse vapors and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be toxic.

SPILL RESPONSES

General Information: Hydroquinone is a poisonous material. Do not walk through spilled material. Ventilate enclosed areas before entering since the solid or crystal form of the material presents a potential dust explosion hazard. Secure potential sources of heat, sparks, flame, impact, friction, electricity and moisture in the immediate spill area and downwind. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent material from entering sewers, waterways, and storm drains. Overflow dams are an effective means to dike material since it is only slightly water soluble and heavier than water. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered. Runoff may be toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

HYDROQUINONE
Division 6.1 (Poisonous Materials)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container of the liquid material is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential ignition sources such as heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

MONITOR THE SITUATION...If released into the atmosphere, hydroquinone is expected to exist primarily in the vapor phase. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Dusts may accumulate in enclosed areas and explode. Extreme caution should be exercised in these areas. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind in enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively in fire situations. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

FOAM...Aqueous Film Forming Foam (AFFF) or compatible hazardous materials foam agents applied to the surface of liquid pools.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

HYDROQUINONE
Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, hydroquinone is expected to degrade. The time frame would depend on the size of the release and atmospheric conditions. Volatilization of hydroquinone from water to the atmosphere is expected to be too slow to be environmentally significant. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is moderately soluble in water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may have limited effectiveness to recover spilled material since the material is moderately water soluble and it is heavier than water. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming may be effective if initiated promptly since the material is moderately water soluble and it is heavier than water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

HYDROQUINONE
Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...If released to soil, hydroquinone is expected to biodegrade under aerobic conditions. Volatilization from either most soil or dry soil is not expected to occur to any significant extent. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Cover solid or crystalline form of material with a plastic sheet or other compatible material. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

September 1992

ISOBUTANE
Class 2.1 (Flammable Gas)

GENERAL INFORMATION

Isobutane is a colorless, flammable, compressed liquefied gas in transportation with a normal boiling point of approximately 10.9°F (–11.7°C). It may be odorless in air at low concentrations, have a mild petroleum, sweet or gasoline like odor, or possibly be treated with a foul skunk-like or other repulsive additive for leakage warning purposes.

Isobutane is practically insoluble in water and lighter. Due to its relatively low boiling point temperature, any spilled liquid will boil or otherwise rapidly vaporize under all but the very coldest environmental conditions. Thus, spills have the potential to generate large amounts of vapor that may be heavier than air, may accumulate and persist in pits, hollows and depressions, and that may travel a considerable distance to a source of ignition and flash back or even explode. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 4.95 pounds per gallon at its boiling point temperature.

Isobutane does not react with water or many other common materials and is primarily known to be incompatible with oxidizing materials that may cause its ignition. It is not corrosive to common metals but may attack some types of plastic and rubber. Toxicity of the product is low by all routes of exposure but contact with very cold liquid or gas may result in frostbite or freeze burns. Products of combustion may include toxic substances.

Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, and weather conditions if isobutane is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire and becomes uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently and possibly rocket. If a cylinder is so threatened, evacuate for a radius of one-third (1/3) mile. (Note: The data and information presented below are for relatively pure isobutane. The properties and hazards of isobutane may be altered if it is shipped or stored as a mixture with other substances.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 49 ppm at 68°F (20°C)

Solubility in Other Chemicals: Soluble to varying degrees in alcohol, chloroform, and ether.

Specific Gravity (Liquid): 0.557 at 68°F (20°C); 0.593 at 10.4°F (–12°C)

Boiling Point: 10.8 to 10.9°F (–11.8 to –11.7°C) at 1 atm.

Melting Point: –255.3°F (–159.6°C); several other values found in the literature appear to be incorrect.

Freezing Point: See melting point

Molecular Weight: 58.12

Heat of Combustion: –10,810 cal/g

Vapor Pressure: 45.27–45.40 psia (3.08–3.09 atm) at 70°F (21.1°C); 72.6 psia (4.94 atm) at 100°F (37.8°C); 90.1 psia (6.13 atm) at 115°F (46.1°C); 110.6 psia (7.53 atm) at 130°F (54.4°C) for high purity isobutane. May differ for mixtures.

Flash Point: –117°F (–82.8°C), closed-cup

Autoignition Temperature: 860–864°F (460–462°C) most commonly reported

Burning Rate: 9.3 mm/minute

Stability: Stable

Corrosiveness: Not corrosive to common metals; may attack some plastics, rubber, and coatings. Polyethylene and polypropylene are specifically cited as vulnerable to attack.

Reactivity with Water: No reaction, but contact of cold liquid isobutane with water (particularly warm or hot water) may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. Pressures may build to dangerous levels if cold liquid isobutane contacts much warmer water in a closed container.

Reactivity with Other Chemicals: May react vigorously, ignite, or explode in contact with strong oxidizing agents or materials. Note that the closely related n-butane has the potential to explode in the presence of nickel carbonyl and oxygen.

IDENTIFICATION

Shipping Names: Isobutane; isobutane mixtures

Synonyms and Tradenames: 1,1-Dimethylethane; 2-methylpropane; iso-methylpropane; trimethylmethane.

Chemical Formula: $(CH_3)_2CHCH_3$

Constituent Components Me each): Shipments of "isobutane" are likely to be 95% to 99.96% pure with the remainder mostly consisting of n-butane and/or propane and no more than 1–2 ppm sulfur.

49 STCC: 49 057 47 (isobutane gas, liquefied); 49 057 50 (isobutane for further refinery processing).

UN/NA Designation: UN1969

IMO Designation: 2.1, flammable gas

Physical State As Shipped: Liquefied compressed gas

Physical State As Released: Boiling liquid, vaporizing liquid, gas, or mixture or gas and aerosols (small liquid droplets), depending on environmental and release conditions; the boiling point of the product is about 10.9°F.

Color of the Shipped Material: Colorless, but very cold may gas appear white at first due to condensation of water vapor in the atmosphere.

Odor Characteristics: Odorless or mild petroleum, sweet, or gasoline odor; some shipments may contain a skunk-like or other repulsive odorant for leakage warning purposes.

Common Uses: General fuel source; organic synthesis of organic chemicals; raw or intermediate material for making synthetic rubber, polyurethane foams and resins.

**FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)**

ISOBUTANE
Class 2.1 (Flammable Gas)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: One authority simultaneously lists a threshold odor concentration of 1.2 ppm in air, a 100% odor recognition concentration of 2 ppm, and a recognition level of 562 ppm at 68°F. A maker of the pure product disagrees and states that isobutane can only be smelled at high concentrations in air.

Unusual Hazards: Extremely flammable heavier than air gas or vapor may travel a considerable distance to a source of ignition and flash back. Vapors and gases may persist in pits, hollows, and depressions. Unconfined as well as confined vapor clouds may explode if ignited. One maker of the product warns that escaping gas may ignite because of friction. Another reports that the material may accumulate static electrical charges which may cause its ignition (presumably upon its release). Also cautioned is that drains may become plugged and valves may become inoperable because of the formation of ice due to expanding vapors or vaporizing liquids.

Short Term Exposure Limit (STEL): Not established.

Time Weighted Average (TWA) Limit: Not established; the limit for closely related n-butane is 800 ppm over each 8 hours of a 40 hour work week (ACGIH TLV, 1990–91; OSHA PEL, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff of liquid to sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the very high concentrations of isobutane gas or vapor that may be present in air at the spill site and directly downwind. Direct contact with the liquid or very cold gas or equipment should also be avoided.

Hazards of Skin or Eye Contact: Contact with very cold liquid isobutane or concentrated cold gas streams may cause frostbite or freeze burns. Frostbite may also occur from contact with the surface of a very cold container of the product. High gas concentrations may cause mild eye irritation; very high gas concentrations may cause mild irritation of mucous membranes (presumably of the nose and throat).

Hazards of Inhalation: Isobutane is of generally low inhalation toxicity. High concentrations of the gas or vapor in air may cause central nervous system depression. Very high concentrations of isobutane gas or vapor in air may cause suffocation by diluting the concentration of oxygen in air below levels necessary to fully support life. Progressively lower levels of available oxygen and higher levels of isobutane may variably cause dizziness, headache, nausea, errors in judgment, disorientation, fatigue, excitation, incoordination, fatigue, accelerated pulse, gasping, confusion, vomiting, anesthesia, prostration, loss of consciousness, coma, convulsions, and eventually death due to respiratory arrest, possibly in seconds and without warning if oxygen levels suddenly drop too low. Isobutane is also reported to be a weak cardiac sensitizer that may cause abnormal heartbeats (i.e., cardiac arrhythmia and ventricular fibrillation) at anesthetic levels in air. An exposure to 57% by volume in air was required to kill 50% of rats within 15 minutes in laboratory experiments; about 42.7% isobutane in air was lethal to 5%of mice exposed for 2 hours. Specific effects at lower levels depend on the duration of the exposure. There are apparently no ill-effects from breathing a concentration as high as 5% (50,000 ppm) isobutane in air for 2 hours according to various authorities, but it should be noted that even this concentration is well above the LFL of the substance.

Hazards of Ingestion: Due to its low boiling point temperature, ingestion of isobutane is unlikely. If it should occur, frostbite of the lips, mouth, and other contacted tissues may possibly be expected.

FIRE HAZARDS

Lower Flammable Limit: Both 1.8% and 1.9% reported

Upper Lower Flammable Limit: Both 8.4% and 8.5% reported

Behavior in Fire: Liquefied flammable gas. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently and possibly rocket in a fire.

Hazardous Combustion Products: Not well-defined; may include carbon monoxide, carbon dioxide, and possibly other toxic constituents. Some authorities report that acrid smoke and irritating fumes are generated upon thermal decomposition of isobutane. One states that reactive hydrocarbons are generated during combustion.

1969

ISOBUTANE
Class 2.1 (Flammable Gas)

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Containers may rupture violently and possibly rocket in a fire. Explosion may result if vapors or gases are ignited in a confined area. There is potential for explosions involving unconfined vapor clouds.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact with the spilled material and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing that preferably does not accumulate static electricity. Although no specific data are available for isobutane, compatible materials for n-butane are reported to possibly include neoprene, neoprene/styrene-butadiene rubber, nitrite rubber/PVC, polyurethane, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Dizziness, drowsiness, or other symptoms of central nervous system depression or oxygen deficiency; frostbite or freeze burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. Isobutane may be a weak cardiac sensitizer; it may not be prudent to administer epinephrine or other sympathomimetic amines to the victim.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.) Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming if warm water is not available.

First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.)

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or liquid or let fire burn if discharge is appreciable. Use carbon dioxide or dry chemical on small fires in the open involving smaller containers that can be safely extinguished and isolated from other flammables. Use water spray or foam on large fires to cool surroundings.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may rupture violently, suddenly release massive amounts of product and possibly rocket when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Note that contact with water may increase the rate of vapor evolution from any exposed pools of liquid isobutane. Direct application of water on pressure relief devices could potentially cause ice to form, thus preventing proper functioning of the devices.

ISOBUTANE
Class 2.1 (Flammable Gas)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the high volatility and flammable nature of isobutane into account while planning the response. Beware of potentially persistent heavy gas accumulations in low areas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Isobutane discharges may expose downwind areas to flammable concentrations over considerable distances in some cases, particularly if the discharge is large. (Note: Since concentrations of isobutane considered toxic are above the LFL of the material, primary hazards are associated with flammable and potentially explosive gas clouds or plumes.)

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isobutane vapors or fumes in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid isobutane pools with water may increase vapor evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid isobutane.

TECHNIQUE

FOAM . . . There is a possibility that application of firefighting foam to the surface of liquid isobutane pools may slow the release of vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if any increases in vapor evolution may affect downwind populations or operational safety.

ISOBUTANE
Class 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid isobutane may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Any remaining traces of isobutane on the ground will vaporize with time.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as nitrogen or carbon dioxide to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of the product into equipment.

WATER SPILL

Liquid isobutane will boil or rapidly vaporize from the water surface with negligible dissolution in the vast majority of cases.

January 1988

ISOBUTYL ACETATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isobutyl acetate is a colorless liquid with a fruity, mild, sweet ester odor that may be disagreeable at higher concentrations in air. It is used as a solvent and in making perfumes, flavoring agents, pharmaceuticals, and other products. Slightly soluble in water and lighter, isobutyl acetate will float to form a surface slick that slowly dissolves. Its flash point is in the range of 64–70°F, thus indicating that it can be easily ignited under many ambient temperature conditions. At warmer temperatures, vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.3 pounds per gallon.

Isobutyl acetate does not react with water and many other common materials but does soften or dissolve various resins and plastics. It is also reactive with a variety of chemicals and contact with explosives may cause an explosion. The toxicity of the substances is generally considered low to moderate via the various potential routes of exposure. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.63–0.7% at 68°F (20°C)
Solubility in Other Chemicals: Soluble in alcohols, esters, ether, hydrocarbons, and ketones.
Specific Gravity (Liquid): 0.870–0874 at 68°F (20°C)
Boiling Point: 233.6–246.2°F (112–119°C) at 1 atm.
Melting Point: –146 to –145.5°F (– 98.9 to –98.6°C)
Freezing Point: –142.8 to –146°F (– 97.1 to 98.9°C)
Molecular Weight: 116.2 *Heat of Combustion: – 7220* cal/g
Vapor Pressure: 12.5 mm Hg (0.242 psia) at 68°F (20°C)
Flash Point: 64–70°F (17.8–21.1°C), closed cup; 75–83°F (23.9–28.3°C), open cup.
Autoignition Temperature: 790–800°F (421–427°C)
Burning Rate: Unavailable
Stability: Stable, but heat contributes to instability.
Corrosiveness: Brass, bronze, or lead compounds not acceptable from a color or contamination standpoint. Will attack wide variety of resins and plastics. Carbon steel, 304SS, lined carbon steel or aluminum not attacked.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with nitrates, strong oxidizers, strong acids or alkali, strong reducing agents, explosives, alkaline earth elemental metals, nitrides, azo or diazo compounds, hydrazines, and caustics.

IDENTIFICATION

Shipping Names: Isobutyl acetate (USDOT and IMO)
Synonyms and Tradenames: Acetic acid, isobutyl ester; acetic acid 2-methylpropyl ester; 2-methyl-1-propyl acetate; 2-methylpropyl acetate; beta-methylpropyl ethandate.
Chemical Formula: $CH_3COOCH_2CH(CH_3)_2$
Constituent Components(% each): 95–99% or more pure with small amounts of water and isobutyl alcohol.
49 STCC: 49 092 07
UN/NA Designation: UN1213
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless, clear
Odor Characteristics: Mild, fruity, sweet, characteristic ester; may be disagreeable in higher concentrations.
Common Uses: Solvent for nitrocellulose, thinners, and topcoat lacquers; mfg. of perfumes, pharmaceuticals, and flavoring agents.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ISOBUTYL ACETATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 4 ppm, but may be 0.35–0.50 ppm or lower according to some authorities.

Unusual Hazards: Flammable, moderately volatile hydrocarbon. Vapors may be heavier than air and may travel to a source of ignition.

Short Term Exposure Limits (STEL): 187 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 150 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air, as may occur in the immediate vicinity and directly downwind of a spill.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid isobutyl acetate may cause mild to moderate irritation and drying of skin. Contact with the eyes may cause moderate irritation.

Hazards of Inhalation: Vapors are irritating to the nose and respiratory tract. High concentrations in air may be narcotic with symptoms including dizziness, weakness, fatigue, nausea, headache, loss of consciousness and possibly death. In laboratory experiments, rats showed no effects from a 3 hour exposure of 3,000 ppm but died from an exposure of 21,000 ppm.

Hazards of Ingestion: Ingestion may cause gastrointestinal irritation, nausea, vomiting, diarrhea, and symptoms of narcosis. The lethal dose for humans is between 1 pint and 1 quart in single doses.

FIRE HAZARDS

Lower Flammable Limit: 1.27% or 2.4%, reported values vary

Upper Flammable Limit: 7.5% or 10.5%, reported values vary

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials are likely to include chlorinated polyethylene, polyurethane, polyvinyl alcohol, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 7500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (7500 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

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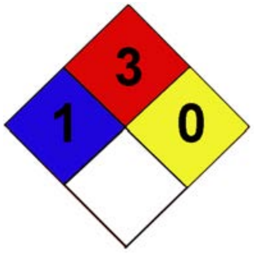
ISOBUTYL ACETATE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes and nose or other symptoms of vapor exposure or ingestion. Eye or skin irritation from direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or irritation of skin persists after washing.

First Aid for Ingestion: If victim is conscious, administer two glasses water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Water fog, alcohol foam, dry chemical, carbon dioxide. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of isobutyl acetate may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that isobutyl acetate is a flammable liquid that slowly dissolves in water.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Isobutyl acetate spills may expose downwind areas to toxic or flammable concentrations, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Isobutyl acetate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of isobutyl acetate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

ISOBUTYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isobutyl acetate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of isobutyl acetate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of isobutyl acetate vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Isobutyl acetate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained isobutyl acetate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

ISOBUTYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow. The spilled product may all dissolve in water before the dam is completed.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

ISOBUTYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating isobutyl acetate before it dissolves in water.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with isobutyl acetate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1991

ISOBUTYLENE
Class 2.1 (Flammable Gas)

GENERAL INFORMATION

Isobutylene, which may be also transported in the U.S. with the shipping name "liquefied petroleum gas", or LPG for short, is a colorless and flammable liquefied gas with a boiling point of approximately 19.6 F in the open environment. Its odor as variously been described as mild and sweetish, like gasoline or faint petroleum, and unpleasant like coal gas. Some shipments may be treated with a foul (skunk-like) additive for leakage warning purposes. The product is used for making aviation gasoline, antioxidants, rubber, plastics, and other chemicals.

Isobutylene is practically insoluble in water and lighter. Due to its low boiling point temperature, any spilled liquid will boil or otherwise rapidly vaporize under all but the very coldest environmental conditions. Thus, spills have the potential to generate large amounts of vapor that may be heavier than air, may accumulate and persist in pits, hollows and depressions, and/or may travel a considerable distance to a source of ignition and flash back or even explode. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently and possibly rocket if exposed to fire or exc essive heat for sufficient time duration. The product weighs approximately 5.2 pounds per gallon at its boiling point temperature.

Isobutylene does not react with water or many other common materials. It is not corrosive to common metals but may attack some types of plastic and rubber. It is reported to be incompatible with oxidizing materials that may cause its ignition, however, and may react with varying results with acids, cyanohydrins, halogens, halogenated compounds monomers, molten sulfur, and polymerizable esters. Toxicity of the product is low by all routes of exposure but contact with very cold liquid or gas may result in frostbite or freeze burns. Products of combustion may include toxic constituents.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if isobutylene is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket. If a cylinder is so threatened, evacuate for a radius of one-third (1/3) mile. (Note: The data and information presented below are for relatively pure isobutylene. The properties of isobutylene may be altered if it is shipped or stored as a mixture with other substances.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 263 ppm at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, benzene, ether, and other organic solvents

Specific Gravity (Liquid): Approx 0.626 at 19.4°F (–7°C); 0.59 to 0.60 at 68°F (20°C)

Boiling Point: 19.6°F (–6.9°C) at 1 atm.

Melting Point: –220.6 to –220.5°F (–140.33 to –104.28°C)

Freezing Point: See melting point

Molecular Weight: 56.11

Heat of Combustion: –10,755 cal/g

Vapor Pressure: Approx 2.62–2.65 atm (38.54–39.0 psia) at 70°F (21.1°C)

Flash Point: –112°F (– 80°C), closed cup; –105°F (– 76°C), unspecified method

Autoignition Temperature: 869°F (465°C)

Burning Rate: Not available

Stability: Stable in normal transportation. Polymerization may possibly occur at elevated temperatures and pressures and/or in the presence of a catalyst such as aluminum chloride or boron trifluoride according to some but not all authorities. One isolated reference reports that exposure to air may result in the formation of peroxides. Such reactions, which typically require a prolonged period of exposure to air, are usually considered hazardous if the peroxides formed are shock-sensitive explosives. Whether or not that is the case here is unclear. The possibility is unlikely to pose a significant threat in episodic discharge situations.

Corrosiveness: Not corrosive to common metals; may affect some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react vigorously, ignite, or explode in contact with strong oxidizing agents or materials. Also reported as incompatible with acids, cyanohydrins, halogens, halogenated compounds, monomers, molten sulfur, and polymerizable esters. Similar substances are incompatible with varying results with aldehydes, certain reactive metals, and possibly other substances.

IDENTIFICATION

Shipping Names: Isobutylene (USDOT and IMO); liquefied petroleum gas (USDOT)

Synonyms and Tradenames: 2-Methylpropene; isobutene; gamma-butylene; uns-dimethylethylene

Chemical Formula: $CH_2 (CH_3)_2$

Constituent Components (% each): Shipments of "isobutylene" may be 99% or more pure with the remainder primarily consisting of similar hydrocarbons. It could not be determined whether lower purity grades are commercially. available.

49 STCC: 49 057 48 (isobutylene); 49 057 52 (liquefied petroleum gas)

UN/NA Designation: UN1055 (isobutylene); UN1075 (LPG)

IMO Designation: 2.1, flammable gas

Physical State As Shipped: Liquefied compressed gas

Physical State As Released: Boiling liquid, vaporizing liquid, gas, or mixture or gas and aerosol (small liquid droplets) depending on environmental and release conditions; the boiling point of the product is about 19.6°F.

Color of the Shipped Material: Colorless gas or liquid, but very cold gas may appear white at first due to condensation of water vapor in the atmosphere.

Odor Characteristics: Variously described as mild and sweetish; like gasoline; like faint petroleum odor; and unpleasant like coal gas. One authority reports that some shipments may contain a skunk-like odorant for leakage warning purposes.

Common Uses: Making aviation gasoline, butyl rubber, and antioxidants for foods, packaging materials and food supplements; making plastics, other polymers, and various chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ISOBUTYLENE
Class 2.1 (Flammable Gas)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Reported values widely differ and include 0.56 ppm, 0.6 ppm, 1.3 ppm, 19.7 ppm, and 2098 ppm for either threshold or recognition levels in air.

Unusual Hazards: Extremely flammable and. volatile heavier than air gas or vapor may travel a considerable distance to a source of ignition and flash back. Vapors and gases may persist in pits, hollows, and depressions. Unconfined as well as confined vapor clouds may explode if ignited. One manufacturer makes the unusual observation that escaping gas may ignite because of friction, which is not implausible if static electricity charges buildup during the venting process. Another reports that drains may become plugged and valves may become inoperable because of the formation of ice during expansion of vapors or vaporization of liquids; this also is plausible.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limits: Unavailable from recognized authority for isobutylene. Both the ACGIH (TLV, 1990–91) and OSHA (PEL, 1989) have adopted a 1000 ppm TWA limit over each 8 hours of a 40 hour work week for LPG. Suppliers recommend exposure limits of 800 to 1000 ppm on the same basis for isobutylene.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff of liquid to sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the very high concentrations of isobutylene gas or vapor that may be present in air at the spill site and directly downwind. Direct contact with the liquid or very cold gas or equipment should also be avoided.

Hazards of Skin or Eye Contact: Contact with very cold liquid isobutylene or concentrated gas streams may cause frostbite or freeze burns. Frostbite may also occur from contact with the surface of a very cold container of the product.

Hazards of Inhalation: Isobutylene is practically nontoxic by inhalation. Nevertheless, it may be mildly irritating to mucous membranes, may act as an anesthetic to some extent, may cause some degree of central nervous system depression, and may cause asphyxiation by diluting the concentration of oxygen in air below levels necessary to fully support life when present in very high concentrations. The effects of progressively higher concentrations of isobutylene in air and resulting lower levels of available oxygen may variously include drowsiness, dizziness, headache, errors in judgment, diminished mental alertness, muscular incoordination, emotional instability, excitation, rapid fatigue, accelerated pulse, gasping, rapid respiration, air hunger, excess salivation, confusion, nausea, vomiting, prostration, loss of consciousness, convulsions, deep coma and death, possibly in seconds and without warning if oxygen levels drop too low. An exposure to about 266,600 ppm for 4 hours was required to kill 50% of rats in laboratory experiments; an exposure to 178,450 ppm for 2 hours was required to obtain the same result in mice. These levels are far above the 18,000 ppm lower flammable limit of the substance. It has been reported by a maker of the product that isobutylene may be a cardiac sensitizer.

Hazards of Ingestion: Due to its low boiling point temperature, ingestion of isobutylene is unlikely. If it should occur, frostbite of the lips, mouth, and other contacted tissues may be expected.

FIRE HAZARDS

Lower Flammable Limit: 1.8%

Upper Flammable Limit: Numerous references report 9.6%; two respected authorities, however, provide an upper limit of 8.8%.

Behavior in Fire: Liquefied flammable gas. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel a a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire and possibly rocket.

Hazardous Combustion Products: Not well-defined; include carbon monoxide and carbon dioxide and possibly other toxic constituents. One authority reports that acrid smoke and fumes are generated upon thermal decomposition of isobutylene.

1055

ISOBUTYLENE

Class 2.1 (Flammable Gas)

See UN/NA Designation for
other ID numbers.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently and possibly rocket in fire. Explosion may result if vapors or gases are ignited in a confined area. There is known potential for explosions involving unconfined vapor clouds.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact with the spilled material and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Dizziness, drowsiness, or other symptoms of central nervous system depression, narcosis, or oxygen deficiency; frostbite or freeze burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. There is a possibility that isobutylene may be a cardiac sensitizer; it may not be prudent to administer epinephrine to the victim.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.)

First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately if frostbite or freeze burns have occurred. (Note: Do not use hot water or rub frozen areas.)

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or liquid or let fire burn if discharge is appreciable. Use carbon dioxide or dry chemical on small fires in the open involving smaller containers that can be safely extinguished and isolated from other flammables. Use water spray or foam on large fires to cool surroundings.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may rupture violently, suddenly release massive amounts of product, and possibly rocket when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Note that contact with water may increase vapor evolution from any pools of liquid isobutylene.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the high volatility and extremely flammable nature of isobutylene into account while planning the response. Beware of possible heavy gas accumulations in low areas.

ISOBUTYLENE
Class 2.1 (Flammable Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Isobutylene discharges may expose downwind areas to flammable concentrations over considerable distances in some cases, particularly if the discharge is large. Distances associated with toxic concentrations are likely to be shorter for this particular material.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isobutylene vapors or fumes in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid isobutylene pools with water may increase vapor evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid isobutylene.

TECHNIQUE

FOAM . . . There is a possibility that application of firefighting foam to the surface of liquid isobutylene pools may slow the release of vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations or operational safety.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid isobutylene may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPINGNACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Any remaining traces of isobutylene on the ground will vaporize with time.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as nitrogen or carbon dioxide to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of the product into equipment.

WATER SPILL

Liquid isobutylene will boil or rapidly vaporize from the water surface with negligible dissolution in the vast majority of cases.

January 1995

ISOBUTYRALDEHYDE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isobutyraldehyde is a colorless liquid with a pungent and sweet odor that may range from pleasant to unpleasant. It is used as a solvent and for making flavors, gas additives, perfumes, brake fluids, plasticizers, and other chemicals and products. It is 6% soluble in water by weight at 77°F and lighter, so may be expected to form a floating surface slick that dissolves fairly rapdily. Its flash point below 0°F indicates that it is easily ignited under most ambient temperature conditions. Its vapor pressure indicates it is a fairly volatile substance that will evaporate at a substantial rate. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.6 pounds per gallon.

Isobutyraldehyde does not react with water or many other common materials and is relatively unstable in normal transportation, being readily oxidized in air to form isobutyric acid. Reactions with non-oxidizing mineral acids or organic acids may initiate violent self-polymerization, and the substance is reactive with a wide variety of other chemicals. It is corrosive to mild steel, and although not of high toxicity, is a strong irritant that may be present in the air in high concentrations. Products of combustion are acrid and may include toxic constituents.

If isobutraldehyde is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 11 g/100 g water at 68°F (20°C); 6.0%W at 77°F (25°C).

Solubility in Other Chemicals: Soluble in acetone, benzene, carbon disulfide, chloroform, ether, ethyl alcohol, and toluene.

Specific Gravity (Liquid): 0.787-0.794 at 68°F (20°C)

Boiling Point: 140.2-149°F (60.1-65°C) at 1 atm.

Melting Point: – 86.6 to – 85°F (– 65.9 to – 65°C)

FreezingPoint: – 86.8°F (– 66°C) or – 112°F (–80°C)

Molecular Weight: 72.11

Heat of Combustion:– 7693 cal/g

Vapor Pressure: 130 mm Hg (2.51 psia) at 68°F (20°C)

Flash Point: – 40 to – 1°F (– 40 to – 1°C), closed cup; –13 to 2°F (– 25 to – 17°C), open cup

Autoignition Temperature: min. 385°F (196°C) max. 490°F (254°C); reported values vary.

Burning Rate: 4.8 mm minute

Stability: Readily oxidizes in air to form isobutyric acid. May polymerize under conditions described above.

Corrosiveness: Attacks mild steel. Tanks should be of aluminum, stainless steel, or glass-lined with blanket of inert gas.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with acids, strong oxidizers, strong reducing agents, dithiocarbamates, alkali and alkaline earth elemental metals, nitrides, possibly epoxides, strong bases, amines, azo and diazo compounds, hydrazines, caustics, organic nitro compounds, peroxides, inorganic sulfides, and unsaturated aliphatic hydrocarbons.

IDENTIFICATION

Shipping Names: Isobutyraldehyde (USDOT and IMO);

Synonyms and Tradenames: Isobutylaldehyde; isobutanal; isobutyric aldehyde; 3-methylpropanal; 2-methyl-1-propanal; alpha-or 2-methylpropionaldehyde; valine aldehyde; isobutanal; isopropyl formaldehyde; 2-methyl propenal.

Chemical Formula: $(CH_3)_2CHCHO$

Constituent Components(% each): 96% or more pure with water, propionaldehyde, butyraldehyde, isobutyl alcohol, and butyl alcohol.

UN/NA Designation: UN2045

IMO Designation: 3.1, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Transparent, colorless

Odor Characteristics: Pungent; pleasant to unpleasant sweet ester.

Common Uses: Solvent; mfg. of rubber antioxidants and accelerators, gas additives, perfumes, plasticizers, brake fluid, resins, flavors, and a variety of other chemicals

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ISOBUTRALDEHYDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Detectable at 0.047-0.336 ppm

Unusual Hazards: Highly flammable volatile liquid with heavier than air and irritating vapors. Product may polymerize violently if contaminated by non-oxidizing mineral acids or organic acids. Fires are easily reignited.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is posed by potentially high vapor concentrations in air, yet ingestion and direct physical contact should also be avoided.

Hazards of Skin or Eye Contact: Contact with liquid isobutyraldehyde may cause mild to severe skin irriation or burns depending upon the extent and duration of exposure. Contact with the eyes may result in severe irritation or burns.

Hazards of Inhalation: Vapors of isobutyraldehye are strongly irritating to the eyes, mucous membranes, and respiratory tract and may cause difficult breathing, coughing, drowsiness, headache and other symptoms. Saturated concentrations in air are fatal to laboratory rats in exposures greater than 15 minutes, yet 1000 ppm can be tolerated repeatedly in 6 hour exposures without fatality.

Hazards of Ingestion: Isobutyraldehyde is a strong irritant and of moderate toxicity in acute oral doses.

FIRE HAZARDS

Lower Flammable Limit: 1.6-2%

Upper Flammable Limit: 10-10.6%

Behavior in Fire: Flammable liquid. May generate quantities of flammable vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Fires are easily reignited.

Hazardous Combustion Products: Acrid fumes and smoke; may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: 1.6-2%

Upper Explosive Limit: 10-10.6%

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Violent polymerization may occur in in presence of non-oxidizing mineral acids or organic acids.

PROTECTIVE CLOTHING AND EQUIPMENT

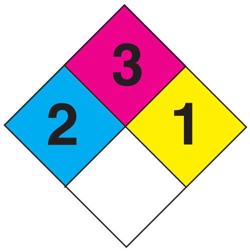
Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic mounted canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

2045

ISOBUTRALDEHYDE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, skin, mucous membrane, or respiratory tract. Other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Get medical attention immediately. (Note: First aid procedures for ingestion are not well documented. Consult a physician as soon as possible.)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water spray. Water may be ineffective except for dilution purposes.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that isobutyraldehyde is highly flammable and evaporates at an appreciable rate. Note that violent polymerization may occur under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Isobutyraldehyde spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ISOBUTRALDEHYDE

Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isobutyraldehyde vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of isobutyraldehyde from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of isobutyraldehyde vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid isobutyraldehyde may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Isobutyraldehyde may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained isobutyraldehyde may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ISOBUTRALDEHYDE

Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances. One manufacturer warns that combustible sorbents should be immersed in water or placed in closed metal containers without delay to prevent spontaneous combustion.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

ISOBUTRALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2003

ISOOCTYL ALCOHOL

Combustible Liquid

GENERAL INFORMATION

Isooctyl alcohol is a clear, colorless liquid having a characteristic odor that is recognizable at 0.138 ppm. It consists of a mixture of closely related isomeric primary alcohols with branched chains having the general formula R-CH_2OH. It is used in conjunction with other chemicals for use as plasticizers. It is also used as a raw material for surfactants, as an antifoaming agent, emulsifier, solvent and used in the production of lacquers, enamels, cellulose nitrate, varnishes, ceramics, paper coatings, rubber, latex and textiles. It is combustible, having a flash point of 180°F, and is reactive with strong oxidizers, inorganic acids, aldehydes, alkylene oxides, halogens and acid anhydrides. It is practically insoluble in water but is soluble in other alcohols, ether, acetone and benzene. It is expected to float on water (as it is lighter than water and only negligibly soluble). The product weighs approximately 6.9 pounds per gallon.

Isooctyl alcohol is stable and will not polymerize. Although there are no signs or symptoms of acute or chronic exposure reported in humans, symptoms of exposure may include central nervous system deppression and irritation of the skin, eyes and membranes. Fumes and vapors are heavier than air, may form explosive mixtures with air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of isooctyl alcohol is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.064 g/100 mL at 77°F (25°C)

Solubility in Other Chemicals: Soluble in other alcohols, ether, acetone and benzene

Specific Gravity (Liquid): 0.83

Vapor Density: 4.5

Boiling Point: 181-196°F (83-91°C)

Melting Point: -105°F (-76°C)

Freezing Point: See melting point

Molecular Weight: 130.3

Heat of Combustion: Unavailable

Evaporation Rate (butyl acetate=1): <1 (reported by one source only)

Vapor Pressure: 0.4 mm Hg at 68°F (20°C)

Flash Point:180°F (82°C) open cup

Autoignition Temperature: 531°F (277°C)

Burning Rate: Unavailable

Flammable Limits: 0.9% (LFL) - 5.7% (UFL)

Stability: Stable

Polymerization Potential: Will not occur

pH: Unavailable

Reactivity with Water: None

Reactivity and Incompatibility: Isooctyl alcohol is incompatible with strong oxidizers (such as perchlorates, permanganates, chlorates, nitrates, and peroxides), inorganic acids, aldehydes, alkylene oxides, halogens and acid anhydrides.

IDENTIFICATION

Shipping Name(s): Alcohols, n.o.s. (Isooctyl alcohol) (USDOT & IMO) or Combustible liquid, n.o.s. (Isooctyl alcohol) (USDOT only)

Synonyms and Tradenames: 6-Methyl-1-heptanol; Isooctanol

CAS Registry No.: 26952-21-6

Chemical Formula: $C_7H_{15}CH_2OH$

Constituent Components (% each): 97% to 100% pure

UN/NA Designation: UN1987 (Alcohols, n.o.s.); NA1993 (Combustible liquid, n.o.s.)

IMO Designation: Not regulated

RTECS Number: NS7700000

NFPA 704 Hazard Rating: 0 (Health): 2 (Flammability): 0 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless liquid

Odor Characteristics: Characteristic odor

Common Uses: Used to form phthalate, maleate, adipate and sebacate esters with the corresponding acids for use as plasticizers. Used as a raw material for surfactants and as an antifoaming agent, emulsifier and solvent. Used in the production of lacquers, enamels, cellulose nitrate, varnishes, ceramics, paper coatings, rubber, latex and textiles.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

*Also 1993

ISOOCTYL ALCOHOL

Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.138 ppm

Unusual Hazards: Fumes and vapors are heavier than air. Vapors may form explosive mixtures with air. Vapors may travel to a distant source of ignition and flash back.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 50 ppm (NIOSH)

Ceiling (C) Limit: Unavailable

IDLH: Not determined

Conditions to Avoid: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers. Avoid inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: May cause skin or eye irritation and possibly central nervous system effects.

Hazards of Skin or Eye Contact: Causes skin and eye irritation. Prolonged contact with the skin may lead to absorption of toxic amounts of product.

Hazards of Inhalation: No signs or symptoms of exposure exist for humans, but expected to be irritating to respiratory tract.

Hazards of Ingestion: No signs or symptoms of exposure exist for humans, but caused central nervous depression in laboratory animals.

FIRE HAZARDS

Lower Flammable Limit: 0.9%

Upper Flammable Limit: 5.7%

Behavior in Fire: Combustible liquid. Vapors are heavier than air, may collect in low areas and may travel to a distant source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Combustion may form carbon dioxide and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Butyl rubber, neoprene, polyvinyl alcohol and Viton® are reported to have a greater than 8 hour breakthrough time. Natural rubber is reported to have a less than one hour breakthrough time and is therefore not recommended as it may degrade.

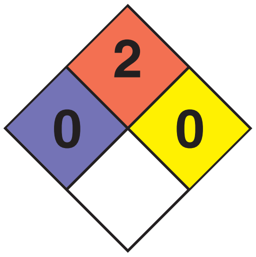
Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1987 *

*Also 1993

ISOOCTYL ALCOHOL

Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if irritation develops or persists. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Seek medical advice on whether or not to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, foam, water spray or carbon dioxide. For large spills use an alcohol type foam concentrate extinguishing agent.

Extinguishing Techniques: Fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Do not use a solid stream of water, since the stream may scatter and spread the fire. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: Isooctyl alcohol is a flammable liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance as needed. Do not use combustible materials, such as sawdust.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited to spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

ISOOCTYL ALCOHOL

Combustible Liquid

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Isooctyl alcohol may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ISOOCTYL ALCOHOL

Combustible Liquid

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ISOOCTYL ALCOHOL

Combustible Liquid

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Sorbent pads or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating product.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Sorbent pads, peat or commercial sorbent materials compatible with product may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

January 1988

ISOPRENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isoprene is a colorless liquid with a mild, aromatic, petroleum-like odor. It is used for making various plastics, rubbers, and other chemicals. The substance is practically insoluble in water and lighter so may be expected to form a floating surface slick. Its flash point of –65°F indicates that it can easily be ignited under all ambient temperature conditions. Its boiling point of 93.4°F indicates that it will boil at high ambient temperatures and will otherwise evaporate rapidly. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, or depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 5.7 pounds per gallon.

Isoprene does not react with water or many other common materials and is considered stable in normal transportation. Although shipped with an inhibitor, excessive heat as in a fire situation may cause self-polymerization resulting in violent rupture of the container. Self-polymerization may also be initiated by rusty iron, acids, azo and diazo compounds, hydrazines, caustics, cyanides, alkali and alkaline earth metals, nitrides, peroxides, phenols, cresols, and inorganic sulfides. Explosions are also possible in the presence of certain metallic elements or alloys. Although toxicity by all routes can be considered low to moderate, the high volatility of isoprene indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

Downwind evacuation should be considered if the product is leaking but not on fire. If a product container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble

Solubility in Other Chemicals: Soluble in acetone, alcohol, and ether.

Specific Gravity (Liquid): 0.681 at 68°F (20°C)

Boiling Point: 93.4°F (34.1°C)

Melting Point: –230.8 to –230.0°F (–146 to –146.7°C)

Freezing Point: –230.7°F (–145.9°C)

Molecular Weight: 68.1

Heat of Combustion: –10471 cal/g

Vapor Pressure: 400 mm Hg (7.73 psia) at 59.7°F (15.4°C)

Flash Point: –65°F (–54°C), closed cup

Autoignition Temperature: min. 743°F (395°C); max. 802°F (427°C); reported values vary.

Burning Rate: 8.6 mm/minute

Stability: Stable in normal transportation, but may polymerize under conditions described above.

Corrosiveness: Not available

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reactive with acids, azo and diazo compounds, hydrazines, caustics, cyanides, alkali and alkaline earth metals, certain other metals, nitrides, peroxides, phenols, cresols, inorganic sulfides, dithiocarbamates, explosives, and aldehydes.

IDENTIFICATION

Shipping Names: Isoprene (USDOT and IMO); isoprene, inhibited (IMO)

Synonyms and Tradenames: 2-Methyl-1,3-butadiene; beta-methylbivinyl; 2-methylbutadiene; hemiterpene; 3-methyl-1,3-butadiene; isopentadiene.

Chemical Formula: $CH_2{=}C(CH_3)CH{=}CH_2$

Constituent Components (% each): 99.8% or more pure with small amount of inhibitor in interstate transportation.

49 SPCC: 49 072 30

UN/NA Designation: UN1218

IMO Designation: 3.1, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid; boils at 93.4°F

Color of the Shipped Material: Colorless

Odor Characteristics: Mild, aromatic, like petroleum

Common Uses: Mfg. plastic, rubber, other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ISOPRENE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 0.005–3.5 ppm; reported values vary.

Unusual Hazards: Highly volatile, flammable liquid with heavier than air vapors. May boil at high ambient temperatures. Excessive heat or chemical contamination may initiate violent self-polymerization in containers.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, sparks and open flame; incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of potentially high vapor concentrations in air.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with liquid isoprene may cause irritation. Contact with the eyes may cause irritation like gasoline.

Hazards of Inhalation: Vapors of isoprene are irritating to the eyes and upper respiratory tract. High concentrations in air are narcotic and may cause headache, dizziness, nausea, incoordination, loss of consciousness, and possibly death. Very high levels may cause asphyxiation. In mice, a concentration of 5% has been fatal, 2% has caused bronchial irritation.

Hazards of Ingestion: Isoprene is considered moderately toxic by ingestion.

FIRE HAZARDS

Lower Flammable Limit: 1.5–2.0%

Upper Flammable Limit: 8.9–9.0%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat or light may cause spontaneous violent polymerization resulting in container rupture. Polymerization may also occur in the presence of numerous chemicals (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or respiratory tract. Symptoms of excessive vapor inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if irritation persists after washing skin.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

1218

ISOPRENE
Class 3 (Flammable Liquid)

FIRE RESPONSE

Extinguishing Materials: Foam, dry chemical, carbon dioxide, water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of isoprene may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Take into account while planning the response that isoprene is a highly volatile and flammable liquid. It may polymerize violently under conditions described in the General Information section. Heavy vapors may persist in low areas for a time.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Isoprene spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isoprene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff' may contain a small amount (if any) of isoprene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of isoprene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

ISOPRENE
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Isoprene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained isoprene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

ISOPRENE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating isoprene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

ISOPRENE
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with isoprene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

ISOPROPANOL
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isopropanol, also known as isopropyl alcohol, is a fairly volatile colorless liquid with a sharp musty odor like rubbing alcohol. It is used in making cosmetics, skin and hair preparations, pharmaceuticals, perfumes, lacquer formulations, dye solutions, antifreezes, rubbing alcohols, soaps, window cleaners and other chemicals and products. The substance is fully soluble in water and will mix freely. Its flash point of 53°F indicates that it may be easily ignited under a wide range of ambient temperature conditions. At warmer temperatures, vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.5 pounds per gallon.

Isopropanol does not react with water or many other common materials and is stable in normal transportation. It is a relatively noncorrosive substance, but may attack some forms of plastics, rubber and coatings, may react with metallic aluminum at high temperatures, and is incompatible with oxidizing materials. Toxicity via the various routes of exposure is comparatively low to moderate, but high concentrations may be present in air in the immediate spill vicinity. Products of combustion may include toxic constituents. Downwind evacuation should be considered on a case by case basis if isopropanol is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.
Solubility in Other Chemicals: Soluble in acetone, alcohols, benzene, and ether.
Specific Gravity (Liquid): 0.785 at 68°F (20°C)
Boiling Point: 180.1°F (82.3°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –127.3°F (–88.5°C)
Molecular Weight: 60.10
Heat of Combustion: –7201 cal/g
Vapor Pressure: 33 mm Hg (0.638 psia) at 68°F (20°C)
Flash Point: 53°F (11.7°C), closed cup; 65°F (18.3°C), open cup.
Autoignition Temperature: 750°F (398.9°C)
Burning Rate: 2.3 mm/minute
Stability: Stable
Corrosiveness: Relatively noncorrosive, but may react with metallic aluminum at high temperatures. May attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizers and with aluminum at high temperatures.

IDENTIFICATION

Shipping Names: Isopropanol (USDOT and IMO); isopropyl alcohol (USDOT and IMO).
Synonyms and Tradenames: 2-Propanol; isopropyl alcohol; dimethylcarbinol; sec-propyl alcohol; rubbing alcohol; 1-methylethyl alcohol; IPA; numerous tradenames.
Chemical Formula: $CH_3CH(OH)CH_3$
Constituent Components(% each): 91–100% pure
49 SPCC: 49 092 05
UN/NA Designation: UN1219
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sharp, musty, like rubbing alcohol
Common Uses: Mfg. of liniments, skin and hair preparations, cosmetics, pharmaceuticals, perfumes, lacquer formulations, dye solutions, antifreezes, rubbing alcohols, soaps, window cleaners, other chemicals; preservative; solvent.

ISOPROPANOL
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor: Concentration: 40–45 ppm
Unusual Hazards: Fairly volatile flammable liquid.
Short Term Exposure Limits (STEL): 500 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 400 ppm over each 8 hours of a 40 hour work Average (TLV-TWA):
Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from prolonged exposure to high vapor concentrations in air as may occur in the spill area and immediately downwind, but ingestion and physical contact should also be avoided.
Hazards of Skin or Eye Contact: Prolonged or repeated contact with liquid isopropanol may result in drying and cracking of the skin due to the defatting action of the product, and some amount may be absorbed through the skin. Contact with the eyes may cause discomfort, irritation, and stinging, but only transitory injury in most cases.
Hazards of Inhalation: Isopropanol vapors may cause mild irritation of the eyes, nose, and throat. High concentrations in air may cause narcosis with symptoms including headache, drowsiness, incoordination, and possibly coma. Humans are uncomfortable at 800 ppm in air. A level of 3000 ppm causes narcosis in laboratory mice.
Hazards of Ingestion: Ingestion of sufficient amounts may cause nausea, vomiting, headache, stomach pain, diarrhea, drowsiness, unconsciousness, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 2.3%
Upper Flammable Limit: 12.7%
Behavior in Fire: Flammable liquid. May generate quantities of flammable vapor upon release. Vapors may travel to a source of ignition and flash back. There is some limited potential that containers may rupture violently in fire.
Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

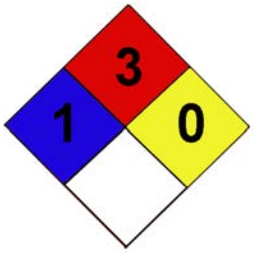
Lower Explosive Limit: 2.5%
Upper Explosive Limit: 12.7%
Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, nitrile rubber, polyethylene, chlorinated polyethylene, polyvinyl chloride, and Viton.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 20,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with front or back mounted organic vapor canister (20,000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1,000 ppm or less) within the use limitations of these devices.

1219

ISOPROPANOL
Class 3 (Flammable Liquid)



FIRST AID

Nonspeciric symptoms: Irritation of the eyes or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if there is skin irritation.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that isopropanol is a fairly volatile flammable liquid.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Isopropanol spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ISOPROPANOL
Class 3 (Flammable Liquid)

TECHNIQUE

MONITOR THE SITUATION . . . Isopropanol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled or in cold weather.

CONSEQUENCE

Hazardous levels of isopropanol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to isopropanol vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of isopropanol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of isopropanol vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid isopropanol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Isopropanol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained isopropanol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

ISOPROPANOL

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ISOPROPANOL

Class 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques. (Note: Activated carbon may be ineffective.)

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1997

ISOPROPENYLBENZENE

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Isopropenylbenzene is a colorless liquid with a characteristic sharp, aromatic odor used as a chemical intermediate. It is reported to be over 95% pure. It is virtually insoluble in water, but is soluble in benzene, diethyl ether, chloroform, ethanol, acetone, carbon tetrachloride and is miscible in alcohol and ether. It is generally stable although it can form peroxides, and contact should be avoided with strong oxidizing agents, strong mineral acids, peroxides, halogens, sulfuric acid , mercury, copper, alkaline pesticides, oleum, aluminum iron chloride, and catalysts for vinyl or ionic polymers. Corrosion of ferrous metals and mild steel can occur in the presence of moisture.

Isopropenylbenzene is irritating to the eyes and skin. It can cause stinging, tearing, redness and swelling to the eyes. Pre-existing skin conditions can be aggravated and exposure can cause dryness, redness, burning and cracking. Inhalation can cause irritation to the respiratory tract and CNS depression. Ingestion can cause irritation of the gastrointestinal tract including nausea, vomiting and diarrhea. Primary routes of entry are skin contact and inhalation.

Isopropenylbenzene is classified as a flammable liquid by US DOT and IMO, however when transported in bulk it can be classified as a combustible liquid. It has a relatively high flash point but it can form explosive mixtures with air at or above 38°C (100.4°F). Vapors are heavier than air, may travel along the ground forming explosive mixtures with air to distant sources of ignition and flash back. Decomposition of this product yields carbon dioxide, carbon monoxide, and hydrocarbons. Some products of decomposition may be corrosive. Complete combustion yields carbon dioxide and water. Runoff from fire control may be toxic and/or flammable and cause environmental damage.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble (<1 mg/m^3 at 22°C(71.6°F))
Solubility in Other Chemicals: Soluble in benzene, diethyl ether, chloroform, ethanol, acetone, carbon tetrachloride. Miscible in alcohol and ether.
Specific Gravity (Water=1): 0.9062 - 0. 920
Vapor Density (Air=1): 4.08
Boiling Point: 165.4°C (329.7°F)
Melting Point: -23.2°C (-9.8°F)
Molecular Weight: 118.19
Heat of Combustion: -5041.2 to -5093.2 kJ/mol.
Evaporation Rate: Unavailable
Vapor Pressure: 4.88 kPa at 75°C (167°F); 13.5 pKa at 100°C (212°F); 32.1 pKa at 125°C (257°F)
Flash Point: 38°C (100.4°F) to 54°C (129.2°F); 83.9°C (183°F) closed cup, also reported.
Autoignition Temperature: 574°C (1065.2°F)
Burning Rate: Unavailable
Flammable Limits: .7% - 1.9% (LEL) - 6.1% (UEL)
Stability: Stable, able to form peroxides.
Polymerization Potential: Can occur, avoid exposure to excessive heat, peroxides, and polymerization catalysts.
pH: 7.0
Corrosiveness: May corrode ferrous metals and mild steel in the presence of moisture.
Reactivity and Incompatibility: Strong oxidizing agents, strong mineral acids, peroxides, halogens, sulphuric acid, mercury, copper, alkaline pesticides, oleum, aluminum iron chloride and catalysts for vinyl or ionic polymers.

IDENTIFICATION

Shipping Name(s): Isopropenylbenzene (USDOT & IMO)
Synonyms and Tradenames: AMS; (1-Methylethene) benzene; 1-Methyl-1-phenylethene; alpha-Methyl styrene; Methyl phenylethene; 2-Phenylpropene; beta-Phenylpropene; 2-Phenylpropylene; beta-Phenylpropylene
CAS Registry No: 98-83-9
Chemical Formula: $C_6H_5CCH_3{=}CH_2$
Constituent Components (% each): Greater than 95% pure.
UN/NA Designation: UN2303
IMO Designation: 3.3
RTECS Number: WL5250000
NFPA 704 Hazard Rating: 1 (Health): 2 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid.
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Characteristic sharp, aromatic odor
Reportable Quantity: See appendix I
Common Uses: Chemical intermediate.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ISOPROPENYLBENZENE

Class 3 (Flammable Liquid) or
Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: .052 ppm (detection); .16 ppm (recognition)

Unusual Hazards: Material is irritating to the skin, eyes, respiratory tract and gastrointestinal tract. Repeated exposure to skin can cause dermatitis. Repeated exposure to vapors or mist generated at high temperatures may cause loss of coordination and central nervous system depression.

Short Term Exposure Limit (STEL): 100 ppm

Time Weighted Average (TLV-TWA): 50 ppm

Ceiling (C) Limit: Unavailable

IDLH: 700 ppm

Conditions to Avoid: Avoid contact with incompatible materials such as strong oxidizing agents, strong acids, peroxides, halogens, sulfuric acid, mercury, copper, alkaline pesticides and oleum. Keep away from heat, sparks, and open flames. May corrode ferrous metals and mild steel in presence of moisture.

HEALTH HAZARDS

Potential Health Hazards: Primary routes of entry are skin contact and inhalation. Pre-existing conditions of the skin and respiratory tract can be aggravated. Symptoms of exposure include skin, eye, respiratory and gastrointestinal irritation.

Hazards of Skin or Eye Contact: Exposure of material to eyes can cause irritation including stinging, tearing, redness and swelling. Exposure to skin can cause irritation including dryness, redness, burning and cracking. Pre-existing skin conditions may be aggravated.

Hazards of Inhalation: Exposure to vapor or mist can cause irritation to the nose, throat and respiratory tract. Symptoms may include central nervous system depression, dizziness, drowsiness, weakness, fatigue, nausea, headache, unconsciousness and even death. Pre-existing conditions such as asthma may be aggravated.

Hazards of Ingestion: Ingestion of this material in low dose has a low toxicity but in larger doses is harmful. Symptoms may include gastrointestinal irritation including nausea, vomiting and diarrhea.

FIRE HAZARDS

Lower Flammable Limit: .7 - 1.9 %

Upper Flammable Limit: 6.1%

Behavior in Fire: Isopropylbenzene is a flammable liquid with a fire potential. It will readily ignite and burn if exposed to sources of ignition, heat and flame. It has a relatively low vapor pressure at ambient temperatures, but if heated it can produce sufficient vapors which are heavier than air, can travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may be invisible and may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Runoff from fire control or dilution water may be flammable and/or toxic and cause environmental damage.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, and various hydrocarbons. Decomposition products may be corrosive.

Hazardous Combustion Products: Complete combustion yields water and carbon dioxide.

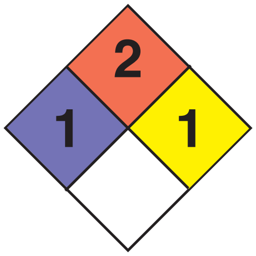
EXPLOSION HAZARDS

Explosive Potential: Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas where vapors can accumulate, since it may present a vapor explosion hazard. Containers exposed to prolonged heat and flame may violently rupture.

2303

ISOPROPENYLBENZENE

Class 3 (Flammable Liquid) or Combustible Liquid



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks <u>with no fire</u>. Suitable materials of construction are Viton® (longer than 8 hours). Butyl rubber, natural rubber, neoprene, nitril rubber and polyvinylalcohol have less than 1 hour resistance to breakthrough and are not recommended for use. Structural firefighting protective clothing will provide only a limited level of chemical personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited

FIRST AID

Nonspecific Symptoms: Primary exposure is from the skin and inhalation. Symptoms include irritation to the eyes, skin, respiratory tract and gastrointestinal tract.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, wash with copious amounts of soap and water for 15 minutes. Remove contaminated clothing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, do not induce vomiting without advice from a physician. This material is an aspiration hazard. If patient is drowsy or unconscious, place patient on left side with the head down. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Alcohol, carbon dioxide, dry chemical, foam, or water spray (fog).

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Do not extinguish fire unless source of leak can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

ISOPROPENYLBENZENE

Class 3 (Flammable Liquid) or Combustible Liquid

SPILL RESPONSES

General Information: Isopropylbenzene is a flammable liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Due to its high boiling point and low vapor pressure at ambient temperatures, isopropenylbenzene is not expected to release much vapor beyond the immediate spill area. However, continuous air monitoring of the immediate area and downwind should be conducted for the presence and/or spread of any hazardous concentrations of flammable and/or toxic vapors especially if the material is involved in a fire or a large spill is involved. The evacuation zone should be expanded as conditions warrant.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind if there is a large spill or the material is involved in a fire.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used effectively to control the production of vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated runoff and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, storm drains and water ways.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents may be applied to the surface of liquid pools to reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, dry dolomite, dry vermiculite or other similar nonporous noncombustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor the situation for the presence of flammable vapor.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

ISOPROPENYLBENZENE

Class 3 (Flammable Liquid) or Combustible Liquid

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . If released into water sources, isopropenylbenzene is expected to float on the surface. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION . . . Material is not water soluble and lighter than water. Overflow dams may be used to confine or divert the spill to a limited area.

CONSEQUENCE

Some material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of any vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Booms may be an effective means to recover spilled material since the material is not water soluble and will float on the surface of the water. Barriers of suitable material may be used to confine the spill to a limited area to prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Continually monitor the integrity of the boom/barriers.

TECHNIQUE

SURFACE SKIMMING . . . Surface skimming may be effective since the material is not water soluble and is lighter than water.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Continually monitor the integrity of the boom/barriers.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat or commercial sorbent materials compatible with isopropenylbenzene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Continually monitor for flammable vapors and eliminate ignition sources.

August 1996

ISOPROPYL ACETATE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isopropyl Acetate is a colorless flammable liquid with a fruity odor used as a solvent for cellulose derivatives, plastics, oils, and fats. It is also used as a solvent for coatings, printing inks, gums and resins, and as a synthetic flavoring ingredient. Isopropyl Acetate is produced from the reaction of propylene and anhydrous acetic acid in the presence of a catalyst. It may also be produced from reacting isopropyl alcohol with acetic acid in the presence of catalysts acid. Isopropyl Acetate vapors and liquid are irritating to the eyes, skin, nose, throat and respiratory tract. The most common routes of exposure are through inhalation and skin contact. It may be poisonous if inhaled or absorbed through the skin for prolonged periods.

The fire potential for isopropyl acetate is high. Vapors may be ignited by heat, sparks, flame, static electricity and other ignition sources in the immediate area and downwind of the release. The material may form explosive mixtures with air. When heated to decomposition, hazardous by-products may include carbon monoxide. Vapors are heavier than air and may settle in low lying areas. Vapors may travel considerable distances to an ignition source and flash back. Normal structural firefighting protective clothing will provide only a limited level of personal protection for working in atmospheres where isopropyl acetate is present. Runoff may be flammable and/or toxic. Isopropyl Acetate is slightly water soluble and floats on the surface of water. This material is incompatible with strong oxidizers. Empty containers containing product residue may be hazardous and proper safety precautions should be followed.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly (3%)
Solubility in Other Chemicals: Acetone, alcohol, ether and most common organic solvents.
Specific Gravity (Liquid): 0.9
Vapor Density (Air=1): 3.5
Boiling Point: 90°C (194°F)
Melting Point: -73°C (-100°F)
Freezing Point: -69°C (-92°F)
Molecular Weight: 102.13
Heat of Combustion: -9,420 BTU/LB. (-5,230 CAL/G.)
Evaporation Rate: Unavailable.
Vapor Pressure: 47 mm Hg at 20°C (68°F)
Flash Point: 2°C (35°F)
Autoignition Temperature: 460°C (860°F)
Flammable Limits: 1.8% (LEL) - 8.0% (UEL)
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with strong oxidizing agents such as hydrogen peroxide, nitric acid, and perchloric acid.
Other Characteristics: Decomposes with heat and produces carbon monoxide.

IDENTIFICATION

Shipping Name(s): Isopropyl Acetate (USDOT & IMO)
Synonyms and Tradenames: 2-Acetooxypropane, 2-Propyl Acetate, 1-Methylethyl Ester, Isopropyl Ester, 2-Propyl Ethanoate, and Paracetat. CAS Registry No: 108-21-4
Chemical Formula: $(CH_3)_2CHOOCCH_3$
Molecular Formula: $C_5H_{10}O_2$
UN/NA Designation: UN1220
IMO Designation: 3.2
RTECS Number: NIOSH/AI4930000
OHMTADS Number: 7216768
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear/colorless
Odor Characteristics: Fruity odor.
Common Uses: Product is used as a solvent for cellulose derivatives, plastics, oils, and fats, coatings, printing inks, gums and resins, and as a synthetic flavoring ingredient.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ISOPROPYL ACETATE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.05 ppm

Unusual Hazards: Exposure to the vapors and liquid may cause severe eye injury requiring several days to heal.

Time Weighted Average (TLV-TWA): 250 ppm

Short Term Exposure Limit (STEL): 310 ppm

IDLH: 16,000 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong oxidizers.

HEALTH HAZARDS

Potential Health Effects: Isopropyl Acetate is irritating to the eyes, skin, nose, throat and upper respiratory tract. It is slightly irritating to mucous membranes and may be poisonous if inhaled or absorbed through the skin. Inhalation can cause chest discomfort, coughing, headache, weakness, drowsiness and unconsciousness. Ingestion may cause headache, nausea, abdominal cramps, and vomiting.

Hazards of Skin Contact: Isopropyl Acetate may be absorbed through the skin in toxic amounts. Skin contact may cause defatting and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, tearing, conjunctivitis, or permanent eye injury requiring several days to heal.

Inhalation Hazards: Inhalation of material may result in nose and throat irritation, respiratory tract irritation, pneumonitis, central nervous system depression, dizziness, suffocation and possibly unconsciousness.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, diarrhea, and abdominal pain.

FIRE HAZARDS

Lower Flammable Limit: 1.8%

Upper Flammable Limit: 8.0%

Behavior in Fire: Isopropyl Acetate is a flammable liquid with high fire potential. It will readily ignite if exposed to sources of heat, sparks, flame and static electricity. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic. Isopropyl Acetate floats on the surface of water and may spread fire beyond the immediate area.

Hazardous Decomposition Products: When heated to decomposition, material releases carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Isopropyl Acetate has a relatively low flash point and ignition temperature. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are polyethylene vinyl alcohol and teflon. Structural firefighting protective clothing will provide a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

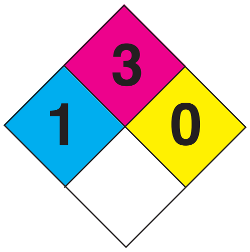
Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are in the range of 250 ppm to 2000 ppm. Protection provided by air purifying respirators is limited.

FIRST AID

Nonspecific Symptoms: Isopropyl Acetate may be absorbed through the skin in toxic amounts. Skin contact may cause defatting and dermatitis. Eye contact with liquid or vapors may cause irritation, redness, tearing, conjunctivitis, or permanent eye injury

1220

ISOPROPYL ACETATE
Class 3 (Flammable Liquid)



requiring several days to heal. Inhalation of material may result in nose and throat irritation, respiratory tract irritation, pneumonitis, central nervous system depression, dizziness, suffocation and possibly unconsciousness. Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, diarrhea, and abdominal pain.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog), or alcohol-resistant foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Isopropyl Acetate is a flammable liquid that may cause environmental contamination. Material floats on the surface of water. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Non-sparking tools and explosion-proof equipment are recommended to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways and storm drains. Underflow dams are an effective means to dike material since it floats on water. As a result, recovery efforts from water borne releases may be effective. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

ISOPROPYL ACETATE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of ignition such as heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...Isopropyl Acetate usually has a short residence time in the atmosphere when released. Since its vapors are heavier than air, the highest concentrations of vapor will be at ground level in low lying and enclosed areas. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

FOAM...Alcohol-resistant foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

ISOPROPYL ACETATE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, isopropyl acetate is expected float on the surface and rapidly volatize into the atmosphere. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is only slightly water soluble. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

Overflow dams may be used to confine the spill to a limited area until appropriate clean-up activities can be initiated. The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may be an effective means to recover spilled material since the material is only slightly water soluble and will float on the surface of the water. Barriers of suitable material may also be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material may travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming may be effective since the material is only slightly water soluble and will float on the surface of the water.

CONSEQUENCE

Material may travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

ISOPROPYL ACETATE
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...If released to soil, isopropyl acetate will display high mobility and has the potential to leach into ground water and potentially contaminate drinking water supplies. Rapid volatilization is expected to occur from both moist and dry soils. Spilled material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

August 1996

ISOPROPYLAMINE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Isopropylamine is a colorless highly flammable, corrosive liquid with an ammonia-like odor used as a solvent and a chemical intermediate in the synthesis of rubber accelerators, pharmaceuticals, dyes, insecticides, bactericides, and textile specialties. Isopropylamine may be produced from the reaction of isopropyl alcohol with ammonia in the presence of a dehydrating catalyst. It may also be produced from acetone and ammonia, and from isopropyl chloride and ammonia under pressure. Isopropylamine is extremely irritating to the eyes, skin and respiratory tract. The most common routes of exposure are through inhalation and skin contact. It may be corrosive upon direct skin contact and poisonous if inhaled or absorbed through the skin for prolonged periods.

The fire potential for isopropylamine is high. Vapors may be ignited by heat, sparks, flame, static electricity and other ignition sources in the immediate area and downwind of the release. The material is highly volatile and may form explosive mixtures with air. When heated to decomposition, the burning material may generate carbon monoxide and oxides of nitrogen. Vapors are heavier than air and may settle in low lying areas. Vapors may travel considerable distances to an ignition source and flash back. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for working in atmospheres where Isopropylamine is present. Runoff may be flammable and/or toxic. Isopropylamine is water soluble. This material is incompatible with strong oxidizers and acids. Empty containers containing product residue may be hazardous and proper safety precautions should be followed.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Miscible.
Solubility in Other Chemicals: Acetone, alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 0.7
Vapor Density (Air=1): 2.0
Boiling Point: 32°C (89°F)
Melting Point: -101°C (-150°F)
Freezing Point: 66°C (150°F)
Molecular Weight: 59.10
Heat of Combustion: -16,940 BTU/LB. (-9,420 CAL/G.)
Evaporation Rate: Unavailable.
Vapor Pressure: 478 mm Hg at 20°C (68°F)
Flash Point: -37°C (-35°F)
Autoignition Temperature: 402°C (756°F)
Flammable Limits: 2.3% (LEL) - 12.0% (UEL)
Stability: Highly volatile.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Incompatible with strong oxidizing agents and acids.
Other Characteristics: Decomposes with heat and produces carbon monoxide and oxides of nitrogen.

IDENTIFICATION

Shipping Name(s): Isopropylamine (USDOT & IMO)
Synonyms and Tradenames: 2-Propanamine, 2-Propylamine, Monoisopropylamine, 1-Methylethylamine, 2-Aminopropane, Propanal, 2-Amino, SEC-Propylamine, NCS 62775 and 2-Propaneamine. CAS Registry No: 75-31-0
Chemical Formula: $(CH_3)_2CHNH_2$
Molecular Formula: C_3H_9N
UN/NA Designation: UN1221
IMO Designation: 3.1
RTECS Number: NIOSH/NT8400000
OHMTADS Number: 7216771
NFPA 704 Hazard Rating: 3 (Health): 4 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear/colorless
Odor Characteristics: Ammonia-like odor
Common Uses: Product is used as a solvent and a chemical intermediate in the synthesis of rubber accelerators, pharmaceuticals, dyes, insecticides, bactericides, and textile specialties.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

ISOPROPYLAMINE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10-20 ppm

Unusual Hazards: Material may be corrosive and toxic upon skin contact. Is severely irritating to the mucous membranes. Exposure to the vapors may cause transient corneal edema.

Time Weighted Average (TLV-TWA): 5 ppm

Short Term Exposure Limit (STEL): 10 ppm

IDLH: 4000 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong oxidizers and acids.

HEALTH HAZARDS

Potential Health Effects: Isopropylamine is extremely irritating to the eyes, skin, nose and throat. It may be poisonous if inhaled or absorbed through the skin. Vapors may cause transient corneal edema. The material is corrosive to body tissues. Skin contact can cause dermatitis and burns. Eye contact may result in burn and permanent injury. Ingestion of alkaline corrosives such as iso propylamine causes burns to the lips, tongue, oral mucosa and esophagus. Vomiting and abdominal pain may also occur. Inhalation of vaporized caustics may result in dyspnea and pulmonary edema. Acute inhalation overexposure may cause erythema, fatigue, chest pains, dizziness, depression, convulsions, narcosis, and possibly unconsciousness.

Hazards of Skin Contact: Isopropylamine may be absorbed through the skin in toxic amounts. Skin contact may cause deep, corrosive burns and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, tearing, blurred vision, burns or transient corneal edema. Permanent eye injury may result.

Inhalation Hazards: Inhalation of vaporized caustics may result in severe nose and throat irritation, dyspnea and pulmonary edema. Acute inhalation overexposure may cause erythema, fatigue, chest pains, dizziness, depression, convulsions, narcosis, and possibly unconsciousness.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache and nausea. Ingestion of alkaline corrosives such as isopropylamine causes burns to the lips, tongue, oral mucosa and esophagus. Vomiting and abdominal pain may also occur.

FIRE HAZARDS

Lower Flammable Limit: 2.3%

Upper Flammable Limit: 12.0%

Behavior in Fire: Isopropylamine is an extremely volatile, flammable liquid with high fire potential. It will readily ignite if exposed to sources of heat, sparks, flame and static electricity. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic. Burning isopropylamine is difficult to control because of the ease of reignition of vapors.

Hazardous Decomposition Products: When heated to decomposition, material releases carbon monoxide and oxides of nitrogen.

EXPLOSION HAZARDS

Explosive Potential: Isopropylamine has high volatility, a low flash point, and a relatively low ignition temperature which produces a high explosion potential. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are butyl rubber (Breakthrough Time = 1 to 4 hours), polyvinyl alcohol and teflon. Structural firefighting protective clothing will provide a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited.

1221

ISOPROPYLAMINE

Class 3 (Flammable Liquid)

FIRST AID

Nonspecific Symptoms: Skin contact may cause corrosive burns and dermatitis. Excessive exposures may cause temporary central nervous system depression with anesthetic effects such as narcosis, dizziness, fatigue, nausea, convulsions, headache, respiratory difficulty, confusion, pulmonary edema, loss of coordination and loss of consciousness. Eye contact may result in transient corneal edema. Inhalation may result in severe nose and throat irritation, dyspnea and pulmonary edema.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and DO NOT INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog), or alcohol-resistant foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be flammable and/or toxic.

SPILL RESPONSES

General Information: Isopropylamine is a highly flammable, corrosive liquid that may cause environmental contamination. Vapors may reignite easily. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Non-sparking tools and explosion-proof equipment are recommended to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways and storm drains. Underflow dams are an ineffective means to dike material since it is miscible in water and it is lighter than water. As a result, recovery efforts from water borne releases are difficult. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

ISOPROPYLAMINE

Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of ignition such as heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...Based on its vapor pressure, isopropylamine is expected to exist almost entirely in the vapor phase in ambient air. Isopropylamine usually has a short residence time in the atmosphere when released. Since its vapors are heavier than air, the highest concentrations of vapor will be at ground level in low lying and enclosed areas. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

FOAM...Alcohol-resistant foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways, and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

ISOPROPYLAMINE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...Isopropylamine is expected to volatize if released into water sources. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is miscible. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

Dams may be used to confine the spill to a limited area until appropriate clean-up activities can be initiated. The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms will not be an effective means to recover spilled material since the material miscible. Barriers of suitable material may also be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material does not float on the surface of the water.

CONSEQUENCE

Material will travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

ISOPROPYLAMINE
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Based on its vapor pressure, isopropylamine should rapidly evaporate from dry surfaces, especially when present in high concentrations in spill situations. Spilled material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment may become contaminated and/or damaged with removed product due to its corrosive effects.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Mechanical equipment may also become damaged with removed product due to its corrosive effects.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

March 1995

ISOPROPYLBENZENE

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Isopropylbenzene, also commonly called Cumene, is a colorless liquid hydrocarbon with a sharp and penetrating odor similar to gasoline. It is used as a solvent, polymerization catalyst, laboratory reagent, and as a raw material for making various other chemicals. Practically insoluble in water and lighter, isopropylbenzene will form a floating and fairly persistent surface slick. A flash point in the range of 96 to 111°F indicates that the product can be easily ignited if subjected to high ambient temperatures or some degree of preheating. Under such conditions, isopropylbenzene vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor from warm or hot liquid isopropylbenzene in confined spaces such as buildings or sewers may explode if ignited. There is some very limited potential for containers of liquid to rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.2 pounds per gallon.

Isopropylbenzene does not react with water or many other common materials and is stable in normal transportation. It is incompatible with strong oxidizing materials and certain strong acids, however, and may attack some forms of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low to moderate. Products of combustion include toxic constituents.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if isopropylbenzene is leaking from its container but not on fire. If a bulk container is exposed to direct flame or fire becomes uncontrollable, consider evacuating for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket. (Note: Although isopropylbenzene has a relatively high boiling point and low vapor pressure, the latter recommendation can be found in the USDOT 1990 Emergency Response Guide.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; reported values of 50 ppm at 68 °F (20°C) and 780 ppm at 77°F (25°C) are somewhat inconsistent.

Solubility in Other Chemicals: Soluble in acetone, benzene, carbon tetrachloride, ether, ethyl alcohol, and many other organic solvents.

Specific Gravity (Liquid): 0.862-0.864 at 68°F (20°C)

Boiling Point: 306.3°F (152.4°C) at 1 atm.

MeltingPoint: – 140.9°F (– 96.1°C)

Freezing Point: See melting point

Molecular Weight: 120.2

Heat of Combustion: – 9,840 cal/g

Vapor Pressure: 3.2-3.5 mm Hg (0.0619-0.0677 psia) at 68°F (20°C)

Flash Point: 96-111°F (35.6-43.9°C), closed cup; reported values vary.

Autoignition Temperature: 795-797°F (424-425°C)

Burning Rate: 5.0 mm/minute

Stability: Stable

Corrosiveness: Not corrosive to metals but may attack some plastics, rubber, and coatings. One authority recommends use of hoses constructed of propylene, Teflon, or Viton.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: May react, ignite, or explode in contact with strong oxidizing agents or materials. Reported to cause temperature and pressure to rise in closed containers when mixed with 70 nitric acid, oleum, or chlorosulfonic acid.

IDENTIFICATION

Shipping Names: Isopropylbenzene (USDOT and IMO).

Synonyms and Tradenames: Isopropylbenzene; isopropyl benzol; cumol; 2-phenylpropane; 1- methylethyl benzene

Chemical Formula: $C_6H_5CH(CH_3)_2$

Constituent Components (% each): 90% or more pure; remainder expected to consist of similar substances in most cases. The properties presented in this guide are for the essentially pure product.

UN/NA Designation: UN1918

IMO Designation: 3.3, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sharp, penetrating, fragrant; aromatic; like gasoline

Common Uses: Raw material for making various other chemicals; polymerization catalyst; laboratory reagent; solvent in paints, enamels, and other substances.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ISOPROPYLBENZENE

Class 3 (Flammable Liquid)
or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Several sources give values in the range of 0.008 to 0.047 ppm; 1.2 ppm has also been reported.

Unusual Hazards: Relatively typical combustible liquid hydrocarbon that borders on being classified as a flammable liquid.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: (Skin) 50 ppm over each 8 hours of a 40 hour work week (ACGIH TLV, 1990 - 91; OSHA PEL. 1989.)

Conditions to Avoid: Heat. fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Although not severe, the major health hazard of isopropylbenzene is associated with inhalation of the vapor concentrations that may be present in air at the spill site and immediately downwind. Direct contact and ingestion should also be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid isopropylbenzene may result in drying and cracking of the skin due to the defatting action of the substance. Also reported is the possibility of redness, thickening, itching, a rash, and/or blistering. Some amounts of isopropylbenzene may be absorbed through the skin but the hazard appears minimal unless the exposure is considerable and prolonged. Contact of liquid isopropylbenzene with the eyes is reported to cause mild irritation. Contact lenses should not be worn when working with this chemical.

Hazards of Inhalation: Exposure to isopropylbenzene vapors in air may cause irritation of the eyes and throat in humans at a concentration on the order of 200 ppm. Other symptoms at unstated concentrations are said to include dryness of the mouth and throat, respiratory tract irritation, sore throat, coughing, shortness of breath, headache, and nausea. Intense short-term exposures may cause narcosis and central nervous system depression with symptoms including dizziness, slight incoordination, and unconsciousness. Recovery from these effects are reported to require one or two days because of the slow rate at which isopropylbenzene is eliminated from the body. Dangerous short-term exposures are deemed unlikely (but not impossible) by various authorities because of isopropylbenzene's relatively low vapor pressure. Although exposure of rats to 8000 ppm in air for four hours and exposure of mice to about 5000 ppm for two hours resulted in death of 50% of the animals in laboratory experiments, it must be observed that the saturated vapor concentration of isopropylbenzene (i.e., the maximum concentration directly over a pool of the liquid) is on the order of 4600 ppm at 68°F and 6050 ppm at 77°F based on available vapor pressure data. Thus, it appears that the irritating properties of isopropylbenzene vapors will normally be of greater concern than the possibility of fatalities resulting from exposures, provided that response personnel and members of the public are properly protected or isolated from extreme and prolonged exposures.

Hazards of Ingestion: Liquid isopropylbenzene is of relatively low toxicity by ingestion. Nevertheless, ingestion may result in a burning sensation in the mouth and stomach, abdominal pain, nausea, vomiting (possibly bloody), chest pain, coughing, hoarseness, salivation, and possibly death in severe exposures. As is the case with similar hydrocarbon substances, it may be expected but is not confirmed) that aspiration of liquid isopropylbenzene into the lungs during vomiting might lead to pulmonary edema and chemical pneumonitis with possibly severe consequences. These latter effects may be delayed in onset.

FIRE HAZARDS

Lower Flammable Limit: 0.9%

Upper Flammable Limit: 6.5%

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite when cool or cold. May generate flammable vapors upon release if heated or if released under high ambient temperature conditions. In such cases, isopropylbenzene vapors may be somewhat heavier than air and may travel some distance to a source of ignition and flash back. Containers have some very limited potential to rupture violently and possibly rocket in fires.

Hazardous Combustion products: Reported to include carbon monoxide, carbon dioxide, aldehydes, and other toxic gases.

EXPLOSION HAZARDS

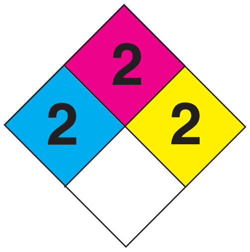
Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from warm or hot liquid are ignited in a confined area. There is a some very limited potential for containers to rupture violently and possibly rocket in fires.

1918

ISOPROPYLBENZENE
Class 3 (Flammable Liquid)
or Combustible Liquid



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include chlorinated polyethylene and Viton/neoprene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister 2500 ppm or less) or a chemical cartridge respirator with a full facepiece (1000 ppm or less) and organic vapor cartridge(s) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the nose, respiratory tract. eyes or skin; symptoms of narcosis and central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward and keep head below hips to reduce risk of aspiration of liquid isopropylbenzene into the lungs.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility (albeit limited) that the container may tear or rupture, possibly rocket, and suddenly release massive amounts of product when exposed to high heat such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operatlons, and other downstream users of potentially contaminated water. Note that intake of liquid isopropylbenzene may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take into account while planning the response that isopropylbenzene is a combustible liquid with a relatively low flash point for such substances. Indeed, some shipments may possibly qualify for flammable liquid status.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Liquid isopropylbenzene discharges may expose downwind areas to toxic and flammable concentrations in some cases. particularly if large quantities have spilled in hot weather and/or the liquid was heated prior to release.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

ISOPROPYLBENZENE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

MONITOR THE SITUATION . . . Isopropylbenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed, particularly for small spills or for spills at less than high ambient temperatures.

CONSEQUENCE

Hazardous levels of isopropylbenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . Water fog or spray applied to isopropylhenzene vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of isopropylbenzene from contact with its airborne vapors .

MITIGATION

Where deemed necessary, contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. (Note: Containment of runoff is only likely to be warranted where critical water bodies and/or environmentally sensitive areas may be impacted. The low solubility of isopropylbenzene in water indicates that runoff from water sprays are unlikely to be significantly contaminated in many cases.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of isopropylbenzene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid isopropylbenzene may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained isopropylbenzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

ISOPROPYLBENZENE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, vermiculite, clay, fly ash, perlite, peat moss, saw dust, straw, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders. scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid isopropylbenzene will form a floating slick on the surface of the water body. Small amounts will dissolve in the water.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards may pose a risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

ISOPROPYLBENZENE
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water-hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skmming devices may be deployed to recover floating isopropylbenzene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose a risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with isopropylbenzene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards may pose a risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources. Note that noncombustible sorbents are preferred when available in order to reduce the hazard in the event of a fire.

TECHNIQUE

ADSORPTION . . . Some small amounts of isopropylbenzene may dissolve in water. Although some of this isopropylbenzene may later volatilize from the water surface, some amounts may remain in the water column for a time. It has been reported that approximately 0.25 ppm of isopropylbenzene in water may cause an adverse taste in fish. Where deemed necessary due to water quality or use considerations, addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Where deemed necessary due to water quality or use considerations, water containing dissolved isopropylbenzene may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body. The technique is better suited to substances with higher vapor pressures than isopropylbenzene but may nevertheless be effective if applied to a contained body of contaminated water for a sufficient period of time.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard, but note that the low solubility of isopropylbenzene in water suggests that air emissions should not be a problem in most cases.

March 1995

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

GENERAL INFORMATION

Isopropyl chloroformate is a colorless poisonous liquid with an irritating, pungent, and acrid odor. Used for making other chemicals, the substance is slightly heavier than water, considered relatively insoluble, and slowly reactive, so may be expected to sink slowly while simultaneously reacting to form hydrochloric acid and probably isopropyl alcohol. Its flashpoint indicates it may be easily ignited at moderate ambient temperatures. Vapors may travel some distance to a source of ignition and flash back, particularly at warmer temperatures. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 9.1 pounds per gallon.

Isopropyl chloroformate is relatively stable in normal transportation, except for an apparent tendency to decompose slowly to hydrogen chloride and isopropyl alcohol, but is likely to be reactive with a variety of other chemicals, certain types of metals and rubber, and certain metallic rusts and salts. Any hydrochloric acid formed will be corrosive to most metals and may cause evolution of flammable and potentially explosive hydrogen gas during the corrosion process. The corrosivity of isopropyl chloroformate itself to bodily tissues is high and requires that all contact with the product be strictly avoided. Products of combustion are both toxic and corrosive and are likely to include hydrochloric acid, phosgene, chlorides or chlorine, chloroformate fumes, carbon monoxide, and other toxic constituents.

If isopropyl chloroformate is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half ($^1/_2$) mile for protection from flying debris if the container should rupture violently. (Note: Specific information on isopropyl chloroformate in the literature is highly limited. Much of this guide is based on the characteristics of methyl chloroformate and ethyl chloroformate. The guide is therefore considered only generally accurate.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble; may react slowly (see below).

Solubility in Other Chemicals: Soluble in ether and benzene.

Specific Gravity (liquid): 1.08–1.09 at 68°F (20°C)

Boiling Point: 220.3–220.8°F (104.6–104.9°C) at 1 atm.

Melting Point: Unavailable

Freezing Point: Unavailable

Molecular Weight: 122.55

Heat of Combustion: Unavailable

Vapor Pressure: Unavailable

Flash Point: 60°F (15.6°C); method unspecified

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable in normal transportation except for possible slow decomposition.

Corrosiveness: any hydrochloric acid formed will be corrosive to most metals, particularly iron and aluminum, with evolution of hydrogen gas. Related products are best handled in glass, lead, porcelain, tantalum, high density polyethylene, polypropylene, or furans. Some are known to attack elastometric materials such as rubber (e.g., neoprene, Viton, etc.).

Reactivity with Water: Related chloroformates are known to react with water, usually slowly, to form corrosive hydrogen chloride or hydrochloric acid while generating heat. This product is likely to also produce isopropyl alcohol upon reaction with water.

Reactivity with Other Chemicals: May decompose with generation of heat, possibly explosively, in presence of iron salts. Known to have once exploded while stored in a refrigerator. Related products are known to be incompatible with oxidizing agents, alkali or caustics, acids, amines, certain metals, rust, and certain types of rubber.

IDENTIFICATION

Shipping Names: Isopropyl chloroformate (USDOT and IMO);

Synonyms and Tradenames: Chloroformic acid, isopropyl ester; isopropylchlorocarbonate; isopropyl chloromethanoate; car bonochloride acid, 1-methylethyl ester; carbonochloridic acid, 1-methylethyl ester.

Chemical Formula: $(CH_3)_2CHOOCCl$

Constituent Components (% each): Related products are usually 94-95% or more pure with remainder including hydrochloric acid, alcohol (isopropyl in this case), alkyl carbonates, and possibly a trace of phosgene.

UN/NA Designation: UN2407

IMO Designation: 6.1, poisonous material

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Similar products have irritating, pungent, and acrid odors.

Common Uses: Making of other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive and flammable liquid. May react with water to form isopropyl alcohol and hydrogen chloride or hydrochloric acid.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is likely to be from inhalation of the relatively high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Isopropyl chloroformate is considered to be corrosive and destructive to living tissue. Contact with the skin or eyes may cause severe acid-type burns. Vapors of the product are irritating to the eyes and likely to cause tears at low concentrations in air.

Hazards of Inhalation: Vapors of related chloroformates are highly irritating to the respiratory tract. Inhalation is likely to cause burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting, chest pain, edema of larynx and bronchi, chemical pneumonitis, pulmonary edema (which may be delayed in onset), convulsions, and possibly death. Exposure to 299 ppm in air for one hour was fatal to 50% of mice in laboratory experiments. A level of 200 ppm was the lowest concentration causing fatalities in rats in five hours.

Hazards of Ingestion: Moderately toxic when ingested. Ingestion of similar products may result in severe burns of the mouth, throat and stomach, stomach pain, nausea, vomiting, esophageal or gastric necrosis, and possibly death.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquid. Vapors may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire due to overheating and/or product decomposition. May generate large quantities of flammable and corrosive gas or vapor upon release.

Hazardous Combustion Products: Toxic and corrosive; likely to include hydrochloric acid, phosgene, chlorides or chlorine, chloroformate fumes, carbon monoxide, and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Note that some chloroformates may explode due to pressure or catalysis.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with isopropyl chloroformate. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full face piece (or the equivalent)

2407

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; choking, coughing, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, halon, foam. Note that isopropyl chloroformate may react with water. Water or foam should be applied with caution at first.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Note that sealed containers may contain some pressure due to product decomposition. Take the corrosive, flammable, reactive, and volatile nature of the product into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Isopropyl chloroformate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities of fumes and vapors are being generated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to isopropyl chloroformate vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain isopropyl chloroformate, hydrochloric acid, and isopropyl alcohol from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM ... There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of hazardous vapors or fumes into the atmosphere. (Note: Since foam is recommended for fire fighting, it may also be beneficial for this purpose. Due to the potential reactivity of the product, apply foam with caution at first. Be advised that various authorities disagree on whether alcohol or regular foam should be used.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION ... The rapid addition of flooding quantities of water to contained liquid isopropyl chloroformate may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid isopropyl chloroformate and its products of reaction with water may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION ... Spreading of liquids may be controlled by absorbing liquid with dry sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

ISOPROPYL CHLOROFORMATE

Division 6.1 (Poisionous Material)

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note that this response will address presence of acid but not alcohol. See next technique for alcohol removal where necessary. Note also that some time may be necessary for reaction of product with water.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION…Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

KEROSENE

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Kerosene is a colorless to light brown liquid commonly known as fuel oil no. 1. It is used as a heating fuel and solvent. It is essentially insoluble in water and lighter, so may be expected to form a floating oil slick. Its minimum flash point of 100ºF indicates that high ambient temperature conditions or some degree of heating is necessary before the product can be ignited easily. Accumulations of vapor from warmed liquid in confined spaces such as buildings or sewers may result in explosions if ignited. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.8-7.1 pounds per gallon.

Kerosene does not react with water or many other common materials and is stable in normal transportation. It is a relatively noncorrosive substance and is primarily incompatible with strong oxidizing materials that may cause its ignition. The toxicity by potential routes of exposure is low to moderate. Products of combustion may include toxic constituents. The product may contain traces of sulfur and benzene.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Essentially insoluble.
Solubility in Other Chemicals: Soluble in other hydrocarbons.
Specific Gravity (Liquid): 0.81-0.85 at 59ºF (15ºC)
Vapor Density: 5.5 (approximately)
Boiling Point: Reports vary, 175-617ºF (79-325ºC)
Melting Point: See freezing point.
Freezing Point: -45 to -55ºF (-43 to -48ºC)
Molecular Weight: 170 (approximately)
Heat of Combustion: -10,300 cal/g
Evaporation Rate (butyl acetate=1): 0.04
Vapor Pressure: .23 - 2 mmHg (0.039 psia) at 68ºF (20ºC); 5 mmHg at 100ºF (37.7ºC); 22 mmHg at 158ºF (70ºC)
Flash Point: 100-162°F (37.7-72.2ºC)
Autoignition Temperature: 428ºF (220°C)
Burning Rate: 4 mm/minute
Flammable Limits: 0.7% (LEL) - 5% (UEL)
Stability: Stable
Polymerization Potential: Will not occur.
pH: Essentially neutral.
Corrosiveness: Noncorrosive
Reactivity with Water: No reaction.
Reactivity and Incompatibility: Avoid contact with strong oxidizers such as chlorine, fluorine, nitrogen tetraoxide, concentrated oxygen, and sodium hypochlorite or other hypochlorites.

IDENTIFICATION

Shipping Name(s): Kerosene (USDOT & IMO)
Synonyms and Tradenames: JP-1; Fuel oil no. 1; Range oil; Kerosine; Coal oil; Lamp oil; Light petroleum; Light distillate; Jet fuel; No. 1 heating oil.
CAS Registry No.: 8008-20-6
Chemical Formula: Complex mixture of petroleum hydrocarbons and additives.
Constituent Components (% each): Varies, generally close to 100% pure.
UN/NA Designation: UN1223
IMO Designation: 3.3, Flammable liquids
RTECS Number: OA5500000
NFPA 704 Hazard Rating: 1(Health): 2(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless to yellowish, oily, may contain red dye.
Odor Characteristics: Strong, characteristic hydrocarbon odor.
Reportable Quantity: See appendix I.
Common Uses: Heating fuel and solvent.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

KEROSENE

Class 3 (Flammable Liquid) or
Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.11 ppm

Unusual Hazards: None

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 100 mg/m^3

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, fire, and sparks, contact with incompatible materials, runoff to sewers or water bodies, inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Health hazards are generally low unless the product is ingested in significant quantities. Nevertheless, all major exposures should be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with fuel oils may cause drying and cracking of the skin due to the defatting action of these products, as well as the possibility of blisters. Contact with the eyes results in mild or negligible irritation in most cases.

Hazards of Inhalation: Prolonged exposure to high vapor concentrations in air may cause headache, drowsiness, irritation of the eyes and nose, and lung irritation. Such concentrations are generally unlikely outdoors, however, except in the immediate vicinity of the spilled product.

Hazards of Ingestion: Ingestion may cause irritation of the gastrointestinal tract, nausea, vomiting, cramping, and possible central nervous system depression with symptoms ranging from headache to anesthesia, coma, and death. Aspiration into the lungs during vomiting may result in coughing, gagging, difficult breathing, substernal distress, rapidly developing pulmonary edema, and delayed bronchopneumonia and pneumonitis with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 0.7%

Upper Flammable Limit: 5%

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite unless warmed. There is some limited possibility that containers may rupture violently in fire. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back.

Hazardous Combustion Products: Thermal decomposition products may include carbon monoxide, carbon dioxide, oxides of sulfur and nitrogen, and other toxic gases.

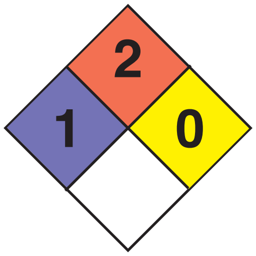
EXPLOSION HAZARDS

Explosive Potential: Explosions may result if vapors of warm liquid are ignited in a confined area. There is some limited possibility that containers may rupture violently in fire.

1223

KEROSENE

Class 3 (Flammable Liquid) or
Combustible Liquid



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, polyurethane, polyvinyl alcohol, Viton® , and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge may suffice.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Foam, dry chemical, carbon dioxide, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of kerosene may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment.

KEROSENE

Class 3 (Flammable Liquid) or Combustible Liquid

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of fuel oil in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to kerosene vapors or fumes may accelerate their dispersal in the atmosphere and will accumulate in low lying areas.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

FOAM . . . Foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications and monitor the area until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

KEROSENE

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TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

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Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating kerosene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with kerosene may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

August 1997

LIQUEFIED NATURAL GAS

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Liquefied natural gas (LNG) is a colorless, odorless liquid whose primary constituent is methane and is used mainly as a fuel or industrial raw material. It has a boiling point as low as -162°C (-260°F) which indicates that in spill situations it will be a vigorously boiling liquid that will evolve large amounts of vapor that are extremely flammable. It burns rapidly at 11.6-12.5 mm/min. which can initially be increased when it comes into contact with the relatively warmer ground or water. Methane vapor is colorless, but boiling LNG produces whitish vapors due to condensation of water vapor from the air. Although lighter than air at normal temperatures, vapor evolved from any spilled LNG will initially be heavier, may accumulate and persist in low areas, and/or may travel a considerable distance to a source of ignition, flash back, and possibly even explode, especially if the gas has accumulated in a confined or partially confined space, such as buildings, sewers or ditches.

Although LNG is non-toxic, it poses a health risk from frostbite like burns from the cryogenic nature of the shipped material as well as an asphyxiation hazard from the high levels of vapors that can be produced. Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if natural gas is leaking from its container. If a bulk container is exposed to prolonged flame, or a fire becomes uncontrollable, an evacuation radius of one-half ($^1/_2$) mile will be necessary just for protection if the container should rupture and instantaneously release the entire liquid contents creating a large fire. At the temperature of LNG, ordinary carbon steels and most alloy steels lose their flexibility, become brittle, and may crack or break without warning.

LNG is primarily used as a fuel and cooking gas, manufacture of chemicals and hydrogenated oils, and in many peak shaving plants in local communities as a means to handle high demands for natural gas.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible; 0.6g/100g water.
Solubility in Other Chemicals: Soluble in ether, benzene and toluene. Slightly soluble in ethanol and acetone.
Specific Gravity: 0.426 at boiling point for liquid; 0.555 at 15.6°C (60.1°F) for gas
Vapor Density: 0.554 at 0°C (32°F)
Boiling Point: -162 to -154°C (-259.6 to -245.2°F)
Melting Point: -182°C (-295.6°F)
Freezing Point: See melting point
Molecular Weight: 16.043
Heat of Combustion: -13214 cal/g
Evaporation Rate: High
Vapor Pressure: 21.84 atm (320.8 psia) at -100°C (-148°F)
Flash Point: Less than -188°C (-306°F)
Autoignition Temperature: 482-632°C (899.6-1169.6°F)
Burning Rate: Approximately 11.6-12.5 mm/min, can be twice this if spilled on relatively warmer ground or water.
Flammable Limits: 5.0% (LEL) - 15% (UEL)
Stability: Stable
Polymerization Potential: Will not occur
Corrosiveness: The light hydrocarbons found in LNG are non-corrosive to metals but may attack some forms of plastics, rubber, and coatings.
Reactivity and Incompatibility: Incompatible with oxidizing agents. Mixtures with bromine pentafluoride, chlorine and yellow mercuric oxide, nitrogen trifluoride, liquid oxygen or oxygen difluoride may explode.

IDENTIFICATION

Shipping Name(s): Natural gas, refrigerated liquid; Methane, refrigerated liquid
Synonyms and Tradenames: Methane; LNG; Natural gas
CAS Registry No: 74-82-8
Chemical Formula: CH_4
Constituent Components (% each): Mostly methane; possibly < 2% ethane, nitrogen or some other hydrocarbon.
UN/NA Designation: UN1972
IMO Designation: 2.1
RTECS Number: PA1490000
Physical Form as Shipped: Liquid
Physical Form as Released: Gas or boiling liquid
NFPA 704 Hazard Rating: 1 (Health): 4 (Flammability): 3 (Reactivity) Note: this rating is for liquefied methane or LNG due to its cold temperature. The lealth rating for methane gas is 0.
Odor Characteristics: Odorless, but may have a faint petroleum-like odor if other hydrocarbons are present.
Reportable Quantity: See appendix I
Common Uses: Primarily used as a fuel and cooking gas, mfg. of chemicals and hydrogenated oils, and by peak shaving plants to handle high demands for natural gas.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

LIQUEFIED NATURAL GAS

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless.

Unusual Hazards: Super cold liquid can cause brittle failure to ordinary carbon and most alloy steels, and may crack without warning. Flames of relatively pure burning methane may not be visible at times. Liquid entering sewers could cause explosions.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable (Simple asphyxiant)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry of liquid into a sewer system or other confined spaces; inhalation of high gas or vapor concentrations; direct physical contact with very cold gas, vapor, or liquid.

HEALTH HAZARDS

Potential Health Hazards: Major hazard is from the high gas concentrations that may be present in air in the immediate spill area and over some distances downwind. Very cold gas, vapor, or liquid may cause frostbite of exposed bodily tissues.

Hazards of Skin or Eye Contact: Contact of the eyes or skin with LNG or its very cold vapors may result in frostbite and subsequent tissue damage. Do not wear contact lenses under conditions that may lead to frostbite in the event of a discharge.

Hazards of Inhalation: Vapors evolved from LNG are considered to be nontoxic. Very high concentrations in air may cause narcosis, central nervous system depression, and asphyxiation due to displacement of oxygen in the atmosphere. Effects are variably reported to include headache, excitation, euphoria, dizziness, drowsiness, incoordination, disorientation, faulty judgment, blurred vision, shortness of breath, increasing fatigue, tremors, nausea, vomiting, irregular heart rhythm, bluish color of the skin, convulsions, loss of consciousness, coma, respiratory arrest, and death. At least one producer indicates the additional possibility that vapors or mists may cause irritation of the nose and throat. Very cold vapors may cause frostbite of respiratory passages.

Hazards of Ingestion: Ingestion of LNG in harmful quantities is considered highly unlikely. Contact with the extremely cold liquid would, at the very least, cause frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 5.0%

Upper Flammable Limit: 15%

Behavior in Fire: Will generate large quantities of vapor upon release. The vapors from LNG are initially heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture in a prolonged fire and instantaneously release the entire contents creating a large fire. Depending on composition, flames may be invisible, pale and faintly luminous, or luminous and clean.

Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.

EXPLOSION HAZARDS

Explosive Potential: High. Explosion may result if gas or vapor is ignited in a confined area. Can readily form explosive mixtures with air. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged heat or fire may fail and releasing the entire contents creating a large fire.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Full fire retardant structural firefighting clothing meeting NFPA standards is recommended for handling spills when fire is the major concern.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations.

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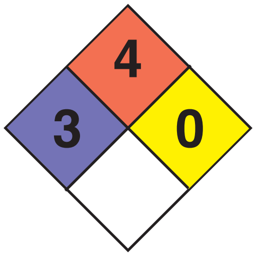
LIQUEFIED NATURAL GAS

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Frostbite or freeze burns of any bodily tissues; headache, euphoria, dizziness, drowsiness, incoordination, faulty judgment, blurred vision, shortness of breath, fatigue, nausea, vomiting, or other symptoms associated with contact or inhalation.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination

First Aid for Skin Contact: In case of skin contact with cold liquid, remove contaminated clothing and wash affected body areas with large amounts of warm water. Clothing should not be removed if it is frozen and stuck to the skin since it will remove the skin or pull out tissue. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming such as wrapping effected area gently in blankets if warm water is not available. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Highly unlikely route of exposure. If occurs, the victim should be treated for potential frostbite. Have victim drink warm water, but do not induce vomiting without medical supervision. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, water spray (fog) or foam. A fine water spray or fog can be used on large discharges to control the fire by preventing its spread and absorbing some of its heat. Do not apply water streams directly on a LNG pool fire since this may greatly and/or suddenly increase the rate of burning and/or the size of the fire by increasing the vaporization rate of the liquid.

Extinguishing Techniques: Stay upwind. Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind. Wear breathing apparatus and appropriate protective clothing. Wear full thermal protective suit as necessary and appropriate. Move container from fire if no risk. Be alert to the possibility that the container may tear or rupture when exposed to prolonged heat, such as from a direct flame, and suddenly release massive amounts of product. Do not extinguish burning gas or liquid unless its flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fire in cargo area, use unmanned hose holder or monitor nozzles for cooling. If this is impossible, withdraw and let burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of a tank due to fire. Note that direct application of water on LNG tank pressure relief devices could result in ice formation, thus preventing their proper functioning. Dike fire control water for proper disposal since it may contain flammable gases.

SPILL RESPONSES

General Information: LNG is highly flammable. Restrict access to area. Eliminate all sources of ignition. Keep unprotected personnel upwind of spill area. Avoid contact with very cold gas or liquid unless properly equipped for such contact. If transfer operations are anticipated, only use equipment specifically designed for use with the material being transferred and its temperature and pressure at the time of transfer. One method to dispose of excess or undesired natural gas is to “flare” it under controlled conditions; consult qualified experts for advice on safe flaring techniques if this approach is considered. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows and depressions. Use combustible gas detectors prior to entering any potentially affected confined space or any low area in which cold, heavier-than-air gases or vapors may have accumulated (but keep in mind that the gas or vapor will become lighter than air as it warms and will disperse more easily). Do not direct water at a venting safety device since this may cause icing to occur. Note that the rapid escape of gas under pressure may generate a static electricity charge that could cause gas ignition. Be advised that the very low temperatures associated with LNG can cause many materials to become brittle and subject to sudden failure or cracking. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of flammable vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

MONITOR THE SITUATION . . . LNG is expected to exist almost entirely in the vapor phase when released into the atmosphere. Depending on the magnitude of the release, flammable concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable gas.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

LIQUEFIED NATURAL GAS

Division 2.1 (Flammable Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors. It can also be used effectively to stop small LNG leaks from valves by forming an ice plug around the super cold metal thereby significantly slowing down the lead to buy more time to complete evaluation.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam can be applied in large volumes to the surface of confined pools of LNG to slow the rate of vapor evolution, particularly after boiling pools have quieted down. Be advised of the possibility of a short-term increase in vapor evolution when the foam (which will be warmer than the LNG) is first applied.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression. Avoid plunging the foam.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to the soil, initially liquid will rapidly boil, generate a large amount of flammable vapors and freeze the ground it is in contact with. Much later, the liquid will reach a less rapid boiling rate thereby evolving less vapors. Containment dikes or barriers using soil, sand or other related materials may be effective to confine the spill to a limited area thereby reducing the surface area and volume of gas generated until liquid evaporates. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material.

CONSEQUENCE

Contained material will take longer to evaporate.

MITIGATION

Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches. Generally practicable only for small leaks. Reducing the spill surface area will decrease the vapor generation.

CONSEQUENCE

Contained material will take longer to evaporate. Mechanical equipment could ignite material.

MITIGATION

Continually monitor for flammable conditions. Dig a deep pit with small area to reduce vapor generation rate. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill pits.

LIQUEFIED NATURAL GAS

Division 2.1 (Flammable Gas)

TECHNIQUE

MECHANICAL REMOVAL . . . Most if not all natural gas components will rapidly vaporize from soil surfaces once the bulk of the LNG has vaporized. Mechanical equipment can be used to grade frozen ground to eliminate any pockets of material.

CONSEQUENCE

Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Continually monitor for flammable conditions.

TECHNIQUE

LET BURN . . . If pool is not ignited or is already ignited, it may be safer to burn the LNG rather than attempt to recover it or put out fire.

CONSEQUENCE

If pool is not well confined, fire may spread and increase burn area. If large amount of liquid spilled, the time of burn may be too long.

MITIGATION

Ensure pool is well confined and unable to spread. Ensure area is well clear of any population that may be exposed to heat or material that could be ignited by intense heat. Consult qualified personnel regarding safety of flaring the gas.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake and monitor situation.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

MONITOR THE SITUATION . . . LNG will vigorously and rapidly boil off the surface of water bodies.

CONSEQUENCE

Flammable concentrations will exist in the area before time and distance from the spill area has diluted the methane gas.

MITIGATION

Evacuate area affected and continually monitor until conditions are safe.

March 1995

MALEIC ANHYDRIDE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Maleic anhydride is a colorless or white crystalline solid that melts at 127°F and that may be shipped as a solid or molten liquid. It has an acrid, choking odor and is used to make various resins, pesticides, oil and fat preservatives, pharmaceuticals, plasticizers, surface coatings, lubricants, dyes, inks, detergents, and other chemicals. A flash point of 215°F indicates that the product must be preheated before ignition can occur. Vapors over a molten surface in a closed tank may be within the explosive range, however, and a cloud of maleic anhydride dust in air may be ignited by a flame or spark and explode. The product is heavier than water and moderately soluble so may be expected to sink and dissolve at a fairly rapid rate. The product weighs approximately 89.2 pounds per cubic foot when solid.

Maleic anhydride reacts relatively slowly with cold water to form maleic acid, but hot water may cause frothing. It is stable in normal transportation and corrosive to some metals when in contact with water. Explosive or violent reactions may occur in the presence of alkali metals or amines at high temperatures, as well as with sodium or potassium carbonate or hydroxide or with aqueous ammonia, pyridine, or calcium hydroxide, particularly if the reaction is confined. Some of these substances may be present in dry chemical or loaded stream fire extinguishers. Copolymerization is possible with controlled mixtures of olefins and catalysts, and the product is also reactive with other chemicals. The substance is a strong irritant to tissue and may cause burns to the skin or eyes, particularly if exposure is prolonged. Products of combustion or decomposition may be acrid and toxic.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 16.3 g/100 g water at 86°F (30°C)

Solubility in Other Chemicals: Appreciably soluble in acetone, alcohol, benzene, chloroform, dioxane, ethyl acetate, ether, toluene, and o-xylene.

Specific Gravity (Liquid): 1.3 at 158°F (70°C); 1.43 for solid

Boiling Point: 386.6-395.6°F (197-202°C) at 1 atm.

Melting Point: 127-140°F (53-60°C)

Freezing Point: 127°F (53°C)

Molecular Weight: 98.06

Heat of Combustion: –3298 cal/g

Vapor Pressure: 0.16 mm Hg (0.003 psia) at 68°F (20°C); 5 mm Hg (0.097 psia) at 146.1°F (63.4°C)

Flash Point: 215°F (102°C), closed cup; 230°F (110°C), open cup.

Autoignition Temperature: 878-890°F (470-477°C)

Burning Rate: 1.4 mm/minute when liquid

Stability: Stable

Corrosiveness: Attacks metals when in contact with water.

Reactivity with Water: Slow reaction evolving maleic acid and heat with cold water. Hot water may cause frothing.

Reactivity with Other Chemicals: Reacts with alkali metals, amines, sodium or potassium carbonate or hydroxide, aqueous ammonia or ammonium hydroxide, pyridine solution, sodium hydroxide, calcium hydroxide, mixtures of olefins and catalysts, and strong oxidizers.

IDENTIFICATION

Shipping Names: Maleic anhydride (USDOT and IMO)

Synonyms and Tradenames: cis-Butenedioic anhydride; 2,5-furandione; maleic acid anhydride; toxilic anhydride; dihydro-2,5-dioxofuran.

Chemical Formula: $(CHCO)_2O$

Constituent Components(% each): 99.5% or more pure

UN/NA Designation: UN2215

IMO Designation: 8, corrosive

Physical State as Shipped: Solid or molten liquid

Physical State as Released: Solid or molten liquid

Color of the Shipped Material: Colorless or white crystalline solid

Odor Characteristics: Acrid, choking

Common Uses: Mfg. of polyester resins, alkyd coating resins, pesticides, oil and fat preservative, pharmaceuticals, plasticizers, lubricants, dyes, inks, detergents, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

MALEIC ANHYDRIDE

Class 8 (Corrosive Material)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.3-0.5 ppm (1.3-2.0 mg/m^3)

Unusual Hazards: Even traces of some chemicals in contact with hot maleic anhydride may initiate reactions producing heat and gases that may rupture closed containers. Some of these chemicals may be found in dry chemical or loaded stream fire extinguishers. Contact with hot water may cause frothing.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 0.25 ppm (1 mg/m^3) over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazards are posed by inhalation of vapors or dusts or eye contact. Other direct physical contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Skin contact with maleic anhydride dust may cause a delayed or immediate burning sensation. Prolonged or repeated contact may cause skin irritation or chemical burns. Molten liquid may cause thermal burns. Eye contact with the solid may result in highly injurious burns. High fume concentrations in air may cause sensitivity to light, double vision, and visualizing rings around lights.

Hazards of Inhalation: Dust and vapor are highly irritating to eyes, nose, throat, and respiratory tract and may cause coughing, nosebleeds, headache, nausea, and vomiting. Severe exposure may result in bronchitis or may provoke attacks in individuals with a previous history of asthma. Levels in air of 1.5-2 ppm cause nasal irritation in 1 minute and eye irritation in 15-20 minutes. (Note: 1 ppm=4.08 mg/m^3.)

Hazards of Ingestion: Maleic anhydride is of low to moderate toxicity by ingestion.

FIRE HAZARDS

Lower Flammable Limit: 1.4%

Upper Flammable Limit: 7.1%

Behavior in Fire: Combustible solid. Will burn but difficult to ignite (unless dust cloud in air). Containers may rupture violently in fire due to overpressurization if exposed to 300°F in presence of certain materials. See General Information section for details.

Hazardous Combustion Products: Unknown, but said to be acrid and toxic.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may explode or rupture in fire under special conditions. Contact with certain other chemicals may result in formation of explosive mixtures. Vapors above molten liquid in tanks or other confined spaces may be in explosive range. Dust clouds may be exploded by flame or a spark.

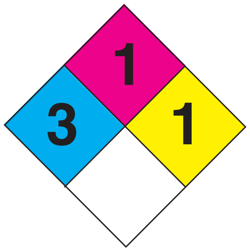
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials (for maleic acid) may include natural rubber, neoprene, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, polyurethane, polyvinyl chloride, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 12.5 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (12.5 ppm or less) or an organic vapor cartridge respirator with a full facepiece (12.5 ppm or less) within the use limitations of these devices. (Note: These devices should also include dust and mist filters.)

2215

MALEIC ANHYDRIDE
Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, skin, throat, or respiratory tract.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide. Water or foam may cause frothing.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the limited possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources where necessary. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Use explosion-proof or spark-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the special reactivity hazards of maleic anhydride into account while planning the response (see General Information section).

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Maleic anhydride, usually, will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of maleic anhydride in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid maleic anhydride with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

MALEIC ANHYDRIDE
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to maleic anhydride vapors or dust may absorb vapors, knockdown dusts, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain maleic acid from contact with vapors or dusts.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Maleic anhydride may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Solutions of maleic anhydride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials. Protect solid product as necessary to prevent wetting by water. Allow molten maleic anhydride to freeze.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material. Keep product dry.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause maleic anhydride dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

MALEIC ANHYDRIDE
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Anion exchangers may also be useful.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

July, 1994

METAM SODIUM
Class 9 (Other Regulated Material)

GENERAL INFORMATION

Metam sodium is clear, yellow to greenish-yellow liquid with a pungent, sulfurous odor. It is not flammable and is shipped as a solution composed of 32.7% metam sodium in water. While it is stable in this proportion, upon contact with additional water, acidic soil components, or exposure to heat, metam sodium will decompose forming carbon disulfide, methylisothiocyanate, monomethylamine and hydrogen sulfide gasses.

Metam sodium solutions are not flammable, however, on decomposition they will release flammable vapors in the form of carbon disulfide and monomethylamine. The rate of decomposition will determine volumes of gas generated.

Metam sodium is soluble and reactive with water. Spills contacting water are expected to distribute in the water column where metam sodium will decompose. Methylisothiocyanate is one of the major products of decomposition and will likely be the predominant threat to water bodies. In soils, metam sodium will distribute freely, like water, and undergo decomposition.

While the vapor pressure of metam sodium is low, gasses produced from decomposition will present a potential for inhalation exposures. Such exposures will result in irritation to the eyes, nose and throat. Direct contact will likely cause irritation, and if exposure is sufficient, burns to the exposed area. If ingested, metam sodium will cause irritation to exposed tissues and may produce symptoms of central nervous system depression.

Metam sodium is used in agriculture as a weed killer, nematocide (worm control), insecticide and soil fumigant. Its controlled decomposition in soils is the method by which metam sodium performs these functions.

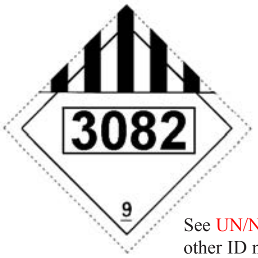
CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble, decomposes.
Solubility in Other Chemicals: Moderate in ethyl alcohol, sparingly soluble in acetone, xylene, and kerosene.
Specific Gravity (Liquid): 1.54 to 1.18
Vapor Density (Air= 1): 1.0
Boiling Point: 110°C (230°F)
Melting Point: Approx. 0°C (32°F)
Freezing Point: Approx. 0°C (32°F)
Molecular Weight: 129.18
Heat of Combustion: Non-flammable.
Vapor Pressure: 21 to 24 mmHg @ 25°C (77°F)
Flash Point: Non-flammable.
Autoignition Temperature: Non-flammable.
Burning Rate: Non-flammable.
Stability: Stable in concentrated aqueous solutions, decomposes when diluted with water, introduced into moist soil, or heated. Slow decomposition occurs on exposure to air. Principal decomposition product is methylisothiocyanate.
Corrosiveness: Alkaline pH, irritant to skin. Also corrosive to copper and copper alloys, brass, aluminum, and zinc.
Reactivity with Water: Stable in concentrated aqueous solutions, decomposes in dilute solutions. Mixtures decompose on dilution with water to release carbon disulfide, methylisothiocyanate, monomethylamine and hydrogen sulfide.
Reactivity with Other Chemicals: Decomposes in the presence of acids and heavy metal salts.

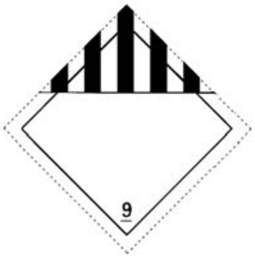
IDENTIFICATION

Shipping Names: Environmentally Hazardous Substance, N.O.S. (Metam sodium).
Synonyms and Tradenames: Sodium -n-methyldithiocarbamate; metam-sodium; VAPAM; methylcarbamodithoic acid, sodium salt; sodium methyldithiocarbamate; SMDC; carbathione; trimaton; n-methylaminodithioformic acid, sodium salt; VPM, maposol; sistan; CAS 137-42-8.
Chemical Formula: $CH_3NHC(S)SNa \cdot 2HOH$
Constituent Components (%o each): Typically 32.7% metam sodium in water.
UN/NA Designation: UN3082 (US), UN2992 (IMO).
IMO Designation: 6.1, poisonous material.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Yellow to light greenish yellow liquid.
Odor Characteristics: Pungent sulfurous odor. Similar to carbon disulfide.
Common Uses: Uses include fungicide, nematocide, weed killer, insecticide, and soil fumigant.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616



METAM SODIUM
Class 9 (Other Regulated Material)



See UN/NA Designation for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Methylisothiocyanate, 45.45 ppm (15 mg/m^3).

Unusual Hazards: Metam sodium decomposes in the presence of heat, water, and in soils to produce carbon disulfide, methylisothiocyanate, monomethylamine and hydrogen sulfide gasses. High decomposition rates may support the development of flammable or toxic gas concentrations.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): Unavailable.

Conditions to Avoid: Contact with water or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Toxic by inhalation, ingestion, and skin absorption. Direct contact with metam sodium solutions or direct contact with contaminated materials is the most likely route of exposure. It is a strong irritant and a possible sensitizing agent. Metam sodium is non-flammable but may decompose producing flammable vapors. Decomposes to produce methylisothiocyanate, carbon disulfide, monomethylamine and hydrogen sulfide gasses.

Hazards of Skin and Eye Contact: Irritating to eye tissues. Exposure to vapors may be irritating. Exposure to liquid or mists can cause comeal damage and corneal edema. Severe exposures may result in bums to the eye. Irritating to the skin. If exposure is prolonged, metam sodium may cause burns to the skin. It can be absorbed through intact skin on repeated or prolonged exposures. Metam sodium is a potential skin sensitizer.

Hazards of Inhalation: May cause irritation to respiratory mucous membranes. May aggravate pre-existing respiratory conditions such as asthma or allergies. In sensitized individuals, may elicit an allergic response such as development of a skin rash or various degrees of respiratory response such as wheezing and asthma. Allergic responses will vary depending on the sensitivity of the individual exposed but could become life threatening.

Hazards of Ingestion: May result in alkali burns to the throat and mouth depending on the concentration. Gastrointestinal distress, nausea, and vomiting are likely to occur depending on the severity of the exposure. May produce symptoms of central nervous system toxicity. Symptoms may include headache, dizziness, loss of coordination, nausea and vomiting. Symptoms may progress, in severe exposures, to loss of consciousness or death.

FIRE HAZARDS

Lower Flammable Limit: Non-flammable.

Upper Flammable Limit: Non-flammable.

Behavior in Fire: Decomposes when exposed to high heat. Decomposition products may include flammable gasses such as carbon disulfide or monomethylamine.

Hazardous Combustion Products: Thermal decomposition products are likely to include methylisothiocyanate, carbon disulfide, monomethylamine and hydrogen sulfide gasses. May also include oxides of nitrogen, oxides of carbon, sulfur, and hydrogen sulfide gasses.

EXPLOSION HAZARDS

Explosiveness: No explosive behaviors identified. Metam sodium is not subject to violent polymerization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with metam sodium liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully covering or encapsulating suits, made of compatible material are appropriate for most large spill situations.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

1075

See UN/NA Designation for
other ID numbers.

METAM SODIUM
Class 9 (Other Regulated Material)

FIRST AID

Nonspecific Symptoms: Irritation to eyes, localized and transient irritation to skin. Burns may result from prolonged exposure. Abdominal distress may result from ingestion. Central nervous system effects may include headache, dizziness and loss of coordination. Irritation to respiratory tissues on inhalation exposures.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 20 minutes, occasionally lifting the eyelid. Seek medical assistance immediately. Risk of permanent eye damage. Prompt medical evaluation is essential. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance immediately.

First Aid for Ingestion: Do not induce vomiting. If victim is conscious, give large amounts of water by mouth. Never give anything by mouth to an unconscious person. Be alert to the development of signs of central nervous system depression including dizziness, nausea, vomiting, and loss of coordination. Provide supportive care and seek medical assistance immediately. Metam sodium solutions are alkali and corrosive to mucous membranes.

FIRE RESPONSE

Extinguishing Materials: Metam sodium is non-flammable. Extinguishing techniques will be based on the fuel involved. Consider that metam sodium solutions will decompose when diluted with water, possibly emitting flammable gasses.

Extinguishing Techniques: Techniques should be selected as appropriate to the burning material. Metam sodium solutions will decompose when diluted with water streams. Runoff will likely be contaminated.

SPILL RESPONSES

General Information: Restrict access to the area and avoid direct contact with spilled product. Prevent liquids from entering sewers and waterways. If waterways are threatened, notify proper authorities, water and sewage treatment plant operators, and other downstream users of the potential for contaminated water. Protect spills, if possible, from contact with firefighting streams or other water sources. Metam sodium decomposes when diluted with water releasing methylisothiocyanate, carbon disulfide, monomethylamine, and hydrogen sulfide. If spilled in water, the predominant contaminant will likely be methylisothiocyanate. Metam sodium is not likely to produce large amounts of airborn contaminants unless exposed to water, heat, or contaminants which would increase the rate of decomposition. Decomposition will occur when metam sodium is exposed to the air but the rate is relatively slow compared to the reactions with contaminants, heat or water.

METAM SODIUM
Class 9 (Other Regulated Material)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Metam sodium may not evolve large amounts of hazardous airborne contaminants if it is kept away from water. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of metam sodium decomposition products may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

MITIGATION

Remove spilled metam sodium as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

FOAM . . . Vapor generation from metam sodium spills may not be sufficient to warrant foam applications. Fire fighting (AFFF) or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of metam sodium decomposition products into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume. Water from foam mixtures may increase decomposition rate.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with metam sodium. Use compatible foam products.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of metam sodium solutions on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Metam sodium solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking product.

CONSEQUENCE

Metam sodium solutions may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Contamination with water will increase the rate of decomposition. Where possible, line containment areas with suitable, impervious material.

LAND SPILL *(CONTINUED)*

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed. Avoid equipment constructed with aluminum, zinc, brass, copper or copper alloys.

TECHNIQUE

ABSORPTION . . . Spilled liquids can be absorbed and immobilized with inert materials such as sand, earth, saw dust, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with metam sodium solution and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL . . . Metam sodium contaminated soil may be removed by shovels, motorized graders, scrapers, loaders, buldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use, with soap and water. Use equipment which is compatible with spilled product. Avoid equipment constructed with aluminum, zinc, brass, copper or copper alloys. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

METAM SODIUM
Class 9 (Other Regulated Material)

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

September 2000

METHACRYLIC ACID, INHIBITED

Class 8 (Corrosive Material)

GENERAL INFORMATION

Methacrylic acid is a colorless liquid with an acrid, repulsive odor. It is used for a variety of purposes and is quite soluble in water and a variety of other chemicals. The toxicity hazards of the product are considerable by all routes of exposure and primarily derive from the highly irritating and corrosive nature of the substance. It has a low pH, and is therefore a strong acid. The flash point of 149ºF indicates the product must be heated before ignition may occur. Above 170ºF explosive vapor/air mixtures may be formed. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back at any temperature above the flash point. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is a possibility that containers of liquid may rupture violently if exposed to certain conditions (see below). The product weighs approximately 8.5 pounds per gallon.

Material may polymerize explosively and will polymerize readily in the absence of an inhibitor due to heating or under the presence of light, oxidizing agents such as peroxides, or in the presence of traces of hydrochloric acid. When transported, methacrylic acid typically contains the monomethyl ether of hydroquinone to prevent polymerization. It may react with water and is highly reactive with oxidizing agents and hydrochloric acid. It is generally stable in normal transportation but this product is not stable when contaminated or the inhibitor has been used up.

Product is flammable and reactive under elevated pressure or temperature conditions. The products of combustion may include toxic and irritating constituents as well as carbon monoxide and carbon dioxide. Liquid freezes to solid at 61ºF.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble

Solubility in Other Chemicals: Soluble in ether, acetone, ethanol, alcohol, ether, ethylene glycol (slightly), methyl ethyl ketone, tetrahydrofuran, carbon tetrachloride, aromatic and chlorinated hydrocarbons, esters, ketones and most organic solvents .

Specific Gravity (Liquid): 1.02

Vapor Density: 2.97

Boiling Point: 325ºF (163ºC)

Melting Point: 61ºF (16ºC)

Freezing Point: See melting point

Molecular Weight: 86.1

Heat of Combustion: Approximately -6310 cal/g

Evaporation Rate (butyl acetate=1): <1

Vapor Pressure: 1 mmHg at 68ºF (20ºC)

Flash Point: 170ºF (76ºC) closed cup; 149ºF (65ºC) open cup

Autoignition Temperature: 750ºF (399ºC)

Burning Rate: Unavailable

Flammable Limits: 1.6% (LEL) - 8.7% (UEL)

pH: 1.2

Stability: Generally stable in normal transportation but this product is not stable when contaminated or inhibitor has been used up.

Polymerization Potential: Material may polymerize explosively. The substance will polymerize readily in the absence of an inhibitor due to heating or under the presence of light, oxidizing agents such as peroxides, or in the presence of traces of hydrochloric acid, with fire or explosion hazard.

Corrosiveness: Attacks metal and is corrosive to bodily tissue. Contact with metals may evolve flammable hydrogen gas.

Reactivity with Water: May react.

Reactivity and Incompatibility: Highly reactive with oxidizing agents and hydrochloric acid. The product may undergo dangerous decomposition, condensation or polymerization. It may react violently with water to emit toxic gases or may become self-reactive under conditions of shock or increase in temperature or pressure.

IDENTIFICATION

Shipping Name(s): Methacrylic acid, inhibited (USDOT & IMO)

Synonyms and Tradenames: Crotonic acid; alpha-Methylcrylic acid; 2-Methyl-2-propenoic acid; Methyl acrylic acid.

CAS Registry No.: 79-41-4

Chemical Formula: $CH_2{=}C(CH_3)COOH$

Constituent Components (% each): Most sources report approximately 100% pure solutions. (Note: Typically contains 100 ppm of the monomethyl ether of hydroquinone to prevent polymerization.)

UN/NA Designation: UN2531

IMO Designation: 8, Corrosives

RTECS Number: OZ2975000

NFPA 704 Hazard Rating: 3(Health): 2(Flammability): 2(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid; freezes to solid at 61ºF.

Color of the Shipped Material: Colorless

Odor Characteristics: Acrid, repulsive odor.

Reportable Quantity: See appendix I.

Common Uses: Stabilizer; component of spray drift retardant; coating for nylon film; appliances. Methacrylic acid cannot be used as an end product, but is processed into other methacrylic products. One important use of methacrylic acid is in paint and varnish resins and dispersions, which in turn are processed into paints and different kinds of varnish.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHACRYLIC ACID, INHIBITED
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.21 ppm.

Unusual Hazards: The substance will polymerize readily due to heating or under the presence of light, oxidizing agents such as peroxides, or in the presence of traces of hydrochloric acid, with fire or explosion hazard.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 20 ppm (70 mg/m^3)

Ceiling (C) Limit: Unavailable

IDLH: No data

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and downwind as well as direct physical contact. Ingestion is also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with the skin may cause redness, skin burns, pain and blisters and may cause an allergic skin reaction. Product may be absorbed through the skin. Contact with the eyes may cause redness, pain, loss of vision and severe deep burns.

Hazards of Inhalation: Inhalation of vapors irritates the mucous membranes and respiratory tract. Symptoms may include sore throat, shortness of breath, coughing, wheezing, headache, nausea and vomiting. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi and chemical pneumonitis.

Hazards of Ingestion: Ingestion may cause abdominal cramps, abdominal pain, burning sensation and weakness.

FIRE HAZARDS

Lower Flammable Limit: 1.6%

Upper Flammable Limit: 8.7%

Behavior in Fire: Exposure of containers to fire or heat may result in violent polymerization and possible container rupture. May generate large quantities of flammable gas or vapor upon release. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back.

Hazardous Combustion Products: Carbon monoxide and carbon dioxide.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Excessive heat may cause spontaneous polymerization resulting in violent container rupture. Violent polymerization may also occur. Above 170°F explosive vapor/air mixtures may be formed.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

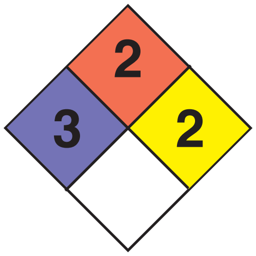
Protective Clothing Required: Equipment should prevent any possibility of skin contact and eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas tight safety goggles, and other impervious and resistant clothing. Viton® and butyl rubber are reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases according to some authorities to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices.

2531

METHACRYLIC ACID, INHIBITED

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues and eyes, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, alcohol type concentrate foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Take the relative volatility, flammability, and toxicity of product into account when planning the response. (Note: Liquid freezes to solid at 61ºF.) Note that there is potential for the product to polymerize under a variety of conditions.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind. Note that even very low concentrations may be irritating to the eyes and respiratory system.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

METHACRYLIC ACID, INHIBITED
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL TYPE CONCENTRATE FOAM . . . There is a possibility that alcohol type concentrate foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

PROTECTION FROM THE WIND . . . If product has solidified, cover solid product with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Methacrylic acid may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

METHACRYLIC ACID, INHIBITED

Class 8 (Corrosive Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

METHACRYLIC ACID, INHIBITED

Class 8 (Corrosive Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2006

METHANOL

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methanol, commonly known as methyl alcohol, is a colorless fairly volatile liquid with a faintly sweet pungent odor like ethyl alcohol. It is used as a raw material for making numerous other chemicals, as a fuel, and as an ingredient in a wide variety of products. The substance is fully soluble in water. Its flash point of 54°F indicates that it can be easily ignited over a wide range of ambient temperature conditions. Vapors of the alcohol are slightly heavier than air and may travel some distance to a source of ignition and flash back in warm weather. Accumulations of vapors in confined spaces such as buildings or sewers may explode if ignited. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 6.6 pounds per gallon.

Methanol does not react with water or many other common materials and is stable in normal transportation. It is reactive with strong oxidizing materials and strong acids, as well as certain other chemicals. It may attack some forms of plastics, rubber, and coatings; and may be somewhat corrosive to lead and aluminum. Products of combustion may include formaldehyde, carbon monoxide, carbon monoxide and unburned methanol.

If methanol is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. For larger spills, increase in the downwind direction as conditions warrant. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 0.792 at 68°F (20°C)
Vapor Density: 1.1
Boiling Point: 148.1°F (64.5C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –144°F (–97.8°C)
Molecular Weight: 32.1
Heat of Combustion: –4677 cal/g
Evaporation Rate (butyl acetate=1): 2.1
Vapor Pressure: 97 mm Hg (1.87 psia) at 68°F (20°C)
Flash Point: 54°F (12.2°C), cc; 61°F (16.1°C), oc.
Autoignition Temperature: Min. 725°F (385°C); max. 878°F (470°C); reported values vary
Burning Rate: 1.7 mm/minute
Flammable (Explosive) Limits: 6% (LEL) – 36% (UEL)
Stability: Stable
Polymerization Potential: Will not occur
pH: Not applicable
Corrosiveness: May be corrosive to lead and aluminum; may attack some forms of plastics, rubber and coatings.
Reactivity with Water: No reaction.
Reactivity with Other Chemicals: Reacts with strong oxidizers, strong acids, strong bases, zinc, perchloric acid, calcium hypochlorite, hypochlorites, peroxides, sodium, potassium or sodium hydroxide and chloroform, sulfuric acid, caustics, aliphatic amines, isocyanates and other materials.

IDENTIFICATION

Shipping Names: Methanol (USDOT & IMO)
Synonyms and Tradenames: Methyl alcohol; Wood alcohol; Methyl hydroxide; Carbinol; Methylol; Monohydroxymethane; Wood spirit; Columbian spirits; Wood naphtha; Pyroxylic spirit; Pyroligneous spirit; Colonial spirit.
CAS Registry No.: 67-56-1
Chemical Formula: CH_3OH
Constituent Components(% each): 99.9–100% pure
UN/NA Designation: UN1230
IMO Designation: 3, flammable liquids; 6.1 toxic substances
RTECS Number: PC1400000
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Instability)
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Faintly sweet, pungent, like ethyl alcohol or wine.
Reportable Quantity: See Appendix I
Common Uses: Solvent for inks, resins, adhesives, dyes; ingredient in paint removers, cleaning products, duplicating fluids, embalming fluids, antifreezes, enamels; mfg. of photo film, plastics, pharmaceuticals, plastics, soaps, stains, coatings, glass, dyes, artificial leather, and many chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHANOL

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Faint odor at 2000 ppm but reported values vary widely, some as low as 4.3, therefore, caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back. Vapors may persist for a time in pits, hollows and depressions. Flowing product may be ignited by self-generated static electricity. Exposures by inhalation or ingestion are a well-known cause of optic nerve and eye damage.

Short Term Exposure Limits (STEL): 250 ppm (325 mg/m^3) (skin) (NIOSH)

Time Weighted Average (TLV-TWA): 200 ppm (260 mg/m^3) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 6000 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazards are from inhalation of the high vapor concentrations that may be present in air or ingestion of methanol. Prolonged and extensive skin contact should also be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid methanol may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Some amount of absorption via the skin may also occur. External contact with the eyes usually causes a mild temporary reaction.

Hazards of Inhalation: Breathing very high vapor concentrations of methanol may result in headache, weakness, drowsiness, light-headedness, nausea, drunkenness, eye irritation, blurred vision, blindness, loss of consciousness, and possibly death. Victims may improve and then get worse again up to 30 hours later.

Hazards of Ingestion: Ingestion of as little as one-third to one-half ounce may cause serious poisoning with effects similar to those of inhalation and absorption through the skin. Toxic effects are more common after ingestion.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 6%

Upper Flammable (Explosive) Limit: 36%

Behavior in Fire: Flammable liquid. May generate quantities of flammable vapor upon release. Vapors may be heavier than air and may travel to a source of ignition and flash back. There is some limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: May include formaldehyde, carbon monoxide, carbon dioxide and unburned methanol.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

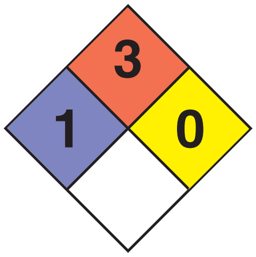
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, nitrile rubber/polyvinyl chloride, polyethylene, chlorinated polyethylene, polyurethane, sytrene-butadiene rubber, Viton®, Teflon® and nitrile-butadiene rubber. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® (CPF 2; SL; CPF 4; Responder®; Responder® CSM; TK; Reflector®; CPE; ThermoPro); Trellchem HPS® suits; Saranex® coated suits; Butyl 874R gloves; Butyl 878 gloves; Neop. Chloroflex N5/N8 gloves; Viton 890® gloves, Viton 892® gloves; 4H® and Silver Shield® brand gloves. The following materials are ***not*** recommended for use: Tychem® PVC; Tychem® F; Tychem® CPF 1; Tychem® QC; Tychem® CPF 3.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 6000 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For concentrations (6000 ppm or less): any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece. For concentrations (5000 ppm or less), any supplied-air respirator operated in a continuous-flow mode. For concentrations (2000 ppm or less), any supplied-air respirator.

1230

METHANOL

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Headache, weakness, and other symptoms of systemic intoxication.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 15 minutes. Get medical attention immediately if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water. Get medical attention immediately. Note: Sources disagree on whether to make a conscious victim vomit if methanol has been ingested.

Note to Physician: One source reports that ethyl alcohol is an accepted antidote. Symptoms may improve and then get worse again up to 30 hours later.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol-resistant foam, water spray or fog. Water may be ineffective except for cooling containers.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Methanol will completely dissolve in water. Dike fire control water for proper disposal since it may contain flammable vapors. Note that methanol has a flash point of 54°F. Note that methanol burns with a rather non-luminous bluish flame.

SPILL RESPONSES

General Information: Methanol is a highly flammable and volatile liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of methanol may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that methanol is a highly flammable substance that may evaporate rapidly, dissolve in water and is lighter than water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

METHANOL
Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Methanol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed.

CONSEQUENCE

Hazardous levels of methanol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb methanol vapors and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Water runoff may contain varying amounts of methanol from contact with its vapors or fumes.

MITIGATION

Contain contaminated water, and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL-RESISTANT FOAM . . . Alcohol-resistant foam applied to the surface of liquid pools may slow the release of methanol vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

METHANOL

Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methanol may be contained by building dikes or barriers using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained methanol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible, non-combustible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

METHANOL
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment techniques.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Activated carbon may not be highly effective.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2003

1-METHOXY-2-PROPANOL

Class 3 (Flammable Liquid)

GENERAL INFORMATION

1-Methoxy-2-propanol is a clear, flammable liquid with a sweet, ethereal odor. It is commonly known as propylene glycol monomethyl ether (PGME). It is soluble in water and is used as a solvent in making acrylics, dyes, inks and stains and as a heat transfer fluid. It is also used in the pharmaceutical industry as an extractant, in cosmetics, adhesives, agrochemical formulations and industrial and household cleaners. It is a flammable liquid, having a low flash point of 91.4°F, indicating that it may be easily ignited at warmer ambient temperatures. It is reactive with strong acids and oxidizing agents and acts as a solvent with many resins, plastics and rubbers. The product weighs approximately 7.7 pounds per gallon.

Prolonged or repeated contact causes defatting of the skin with irritation, dryness and cracking. Exposure may cause central nervous system depression and irritation of the eyes, skin and mucous membranes. PGME has a vapor pressure of 10.9 mm Hg at 68°F, making it a moderate hazard at normal ambient temperatures. Vapors are heavier than air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers. Products of combustion may include toxic gases.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of 1-methoxy-2-propanol is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 0.924
Vapor Density: 3.11
Boiling Point: 247.2°F (119.6°C)
Melting Point: -143°F (-97°C)
Freezing Point: See melting point
Molecular Weight: 90.1
Heat of Combustion: -7580 cal/g
Evaporation Rate (butyl acetate=1): 0.71
Vapor Pressure: 10.9 mm Hg at 68°F (20°C)
Flash Point: 91.4°F (33°C)
Autoignition Temperature: 546.8°F (286°C)
Burning Rate: Unavailable
Flammable Limits: 1.7% (LFL) - 11.5% (UFL)
Stability: Stable under normal conditions
Polymerization Potential: Will not occur
pH: Unavailable
Reactivity with Water: None
Reactivity and Incompatibility: Oxidizing agents (such as perchlorates, peroxides, permanganates, chlorates, nitrates, chlorine, bromine and fluorine), strong acids (such as sulfuric acid, hydrochloric acid, and nitric acid) or isocyanates. This substance acts as a solvent with many resins, plastics and rubbers.

IDENTIFICATION

Shipping Name(s): 1-Methoxy-2-propanol (USDOT & IMO)
Synonyms and Tradenames: 1-Methoxy-2-hydroxypropane; Propylene glycol monomethyl ether (PGME); 1-Methoxypropan-2-ol; alpha-Propylene glycol monomethyl ether; Dowanol 33b; Dowanol pm; Dowtherm 209; Glycol ether pm; Methoxy ether of propylene glycol; Methoxypropanol, alpha isomer; Polypropylene glycol methyl ether; Poly-solve mpm; Propasol solvent m; Propylene glycol 1-methyl ether; Propylene glycol methyl ether; 1-Methoxy-2-hydroxypropane
CAS Registry No.: 107-98-2
Chemical Formula: $CH_3OCH_2CH(OH)CH_3$
Constituent Components (% each): Typically 98% to 100% pure
UN/NA Designation: UN3092
IMO Designation: 3, Flammable liquids
RTECS Number: UB7700000
NFPA 704 Hazard Rating: 0 (Health): 3 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear, colorless liquid
Odor Characteristics: Sweetish odor, ethereal odor
Common Uses: It is used as a solvent in making acrylics, dyes, inks and stains and as a heat transfer fluid. Widely used in the surface coating industry, as a solvent and to regulate flow, leveling and coalescence. It is also used in the pharmaceutical industry as an extractant, in cosmetics, adhesives, printing inks, agrochemical formulations and industrial and household cleaners.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1-METHOXY-2-PROPANOL

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10 ppm

Unusual Hazards: Product is flammable. Fumes and vapors are heavier than air, may travel to a distant source of ignition and flash back.

Short Term Exposure Limit (STEL): 150 ppm (553 mg/m^3) (NIOSH & ACGIH)

Time Weighted Average (TLV-TWA): 100 ppm (NIOSH & ACGIH)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat or sources of ignition; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to the high vapor concentrations that may be present in the local spill area and immediately downwind.

Hazards of Skin or Eye Contact: May cause skin and eye irritation. Prolonged and/or repeated contact causes defatting of the skin with irritation, dryness, cracking or folliculitis.

Hazards of Inhalation: May cause respiratory tract irritation. Inhalation of high concentrations may cause central nervous system effects characterized by nausea, headache, dizziness, unconsciousness and coma. Vapors may cause dizziness or suffocation.

Hazards of Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause central nervous system depression, headache, dizziness, drowsiness and nausea. Prolonged exposure may cause collapse, unconsciousness, coma and possible death due to respiratory failure.

FIRE HAZARDS

Lower Flammable Limit: 1.7%

Upper Flammable Limit: 11.5%

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas and may travel to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: May include carbon monoxide, carbon dioxide and irritating and toxic fumes and gases.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

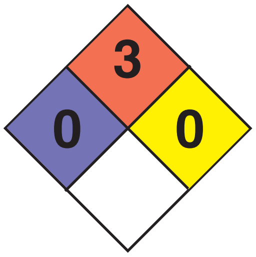
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, nitrile, neoprene, natural rubber (all reported to have a greater than 8 hour breakthrough time). Viton® has a reported breakthrough time of 165 minutes. Based on the chemical subclass, the following apparel may have a greater than 8 hour breakthrough time: Tychem® 9400, Tychem® BR and Tychem® TK. (NOTE: According to Dupont, prediction of chemical resistance of a material from data on other chemicals has not been successful. However, when data is unavailable, information on related chemicals within a sub-class may at least rank alternative chemical protective materials as to their probable chemical resistance.)

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

3092

1-METHOXY-2-PROPANOL

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Defatting of the skin with irritation, dryness, and cracking. May cause central nervous system depression. May cause eye, skin, respiratory and digestive tract irritation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if irritation develops or persists. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Seek medical advice on whether or not to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, alcohol-resistant foam, water spray, fog or carbon dioxide.

Extinguishing Techniques: Toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: 1-Methoxy-2-propanol is a flammable liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

1-METHOXY-2-PROPANOL

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic and/or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression. Flashback may occur.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashback may occur.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Spills may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

1-METHOXY-2-PROPANOL
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

1-METHOXY-2-PROPANOL
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July, 1994

METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl acrylate is a clear, colorless liquid with an acrid odor. Vapors are irritating and will induce tear formation in the eyes. Methyl acrylate is a mobile, volatile, and flammable liquid weighing approximately 8 pounds per gallon. The liquid is less dense than water and if spilled on water, will tend to float on the surface.

Methyl acrylate vapors may travel a considerable distance to a source of ignition. Vapors are heavier than air and may concentrate in low lying areas or confined spaces. Vapors may ignite and flashback to the source and if ignition occurs in a confined setting, ignition may proceed explosively.

Methyl acrylate will polymerize readily in the presence of Uv light, sunlight or heat. Contact with peroxides, oxidizers, nitrates, azides, strong bases, strong acids and catalytic metals such as copper and iron can also initiate violent or explosive polymerization reactions. Liquid methyl acrylate is typically treated with monomethyl ether of hydroquinone and stored in a 5 - 8% oxygen atmosphere to inhibit polymerization. The inhibitor may become depleted in a spill situation or in the presence of heat. If containers are exposed to heat, violent polymerization and container rupture is possible. Vapors are not inhibited and may polymerize. If this occurs in confined spaces such as vents or stacks, polymer accumulations may be sufficient to plug these spaces.

Methyl acrylate is toxic by all exposure routes and may be absorbed through the skin. Skin exposures will likely result in severe irritation or burns. Inhalation effects may result in irritation or burns to respiratory mucous membranes depending on the exposure.

Methyl acrylate is used in a variety of processes including the manufacture of acrylic polymers, surfactants and vitamin B_1. It is also used in the manufacture of leather finishing resins, textile and paper coatings, and plastic films.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 6 gm/100 ml.
Solubility in Other Chemicals: Soluble in alcohol and ether.
Specific Gravity (Liquid): 0.95
Vapor Density (Air =1): 3.0
Boiling Point: 80.5°C (176.9°F)
Melting Point: -76.5°C (-105.7°F)
Freezing Point: -76.5°C (-105.7°F)
Molecular Weight: 86.09
Heat of Combustion: -5500 cal/gm
Vapor Pressure: 65 - 70 mmHg @ 20°C (68°F)
Flash Point: -3 to -3.8°C (26.6 to 25.16°F) OC
Autoignition Temperature: 468°C (874.4°F)
Burning Rate: Unavailable.
Stability: Readily polymerizes. Polymerization is enhanced in the presence of heat or light.
Corrosiveness: Not corrosive.
Reactivity with Water: Impurities in water could contribute to initiating polymerization.
Reactivity with Other Chemicals: Peroxides, oxidizers, nitrates, azides, strong bases, strong acids and catalytic metals such as copper and iron can initiate violent or explosive polymerization reactions.

IDENTIFICATION

Shipping Names: Methyl Acrylate, Inhibited
Synonyms and Tradenames: 2-propenoic acid, methyl ester; acrylic acid, methyl ester; CAS 96-33-3.
Chemical Formula: $CH_2{:}CHCOOCH_3$
Constituent Components (% each): Methyl acrylate 100%, inhibited with 15 - 20 ppm monomethyl ether of hydroquinone.
UN/INA Designation: UN1919
IMO Designation: 3.2, flammable liquid.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Colorless.
Odor Characteristics: Acrid odor.
Common Uses: Used in the manufacture of acrylic polymers and surfactants. Also used in the manufacture of leather finishers, textile and paper coatings, plastic films, and vitamin B_1.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.0047 ppm (0.017 mg/m^3)

Unusual Hazards: Uninhibited liquid is a violent polymerization hazard. Vapors are not inhibited and may also polymerize. Contaminants, sunlight, Uv light, and heat may initiate polymerization. Liquid is inhibited against polymerization and 5 - 8% oxygen atmospheres are required for inhibitor to work. Temperatures in excess of 38.8°C (100°F) will increase polymerization potential. Liquids readily polymerize on loss or inactivation of inhibitor. Flammable vapors may travel considerable distance to source of ignition and flashback to source.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): 10 ppm (35 mg/m^3) skin., OSHA PEL - TWA

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: *Toxic* by ingestion, and to a lesser degree, by absorption and inhalation. Irritant to skin and eyes. Highly irritating to eyes, skin and mucous membranes. Inhalation exposure may result in severe irritation to the respiratory mucous membranes, pulmonary edema, and in severe cases, chemical pneumonia.

Hazards of Skin and Eye Contact: Exposure to eyes may result in severe irritation and corneal injury. Vapors may be irritating to eyes and cause tearing. Skin contact may result in severe irritation, redness, blistering or burns. Severity increasing with quantity and duration of exposure. Toxic by skin absorption on prolonged contact.

Hazards of Inhalation: Primarily an irritant to respiratory mucous membranes. Prolonged exposure to excessive vapors may result in varying degrees of respiratory impairment including burning sensation, coughing, wheezing, shortness of breath. Severe exposures may result in pulmonary edema and chemical pneumonia. Development of pulmonary symptoms may be delayed. Risk of systemic toxicity slight by inhalation route.

Hazards of Ingestion: Severe irritation or burns of the mouth, throat, stomach and associated tissue. May cause nausea, vomiting, and gastrointestinal distress. May produce symptoms of dizziness, difficulty in breathing, and nervousness.

FIRE HAZARDS

Lower Flammable Limit: 2%

Upper Flammable Limit: 12%

Behavior in Fire: May polymerize violently or explosively in fire situations. Intact containers may rupture violently if exposed to heat due to runaway polymerization of methyl acrylate. Temperatures above 38.8°C (100°F) may favor polymerization reaction. Smoke may contain toxic and irritating vapors. Vapors are heavier than air and will tend to collect in confined spaces or low lying areas. Vapor concentrations may present a source for ignition and flashback to the source.

Hazardous Combustion Products: May include unburned product, aldehydes, oxides of carbon and other constituents.

EXPLOSION HAZARDS

Explosiveness: Vapor mixtures within the flammable limits may ignite explosively. Loss of inhibitor, exposure to heat, and contamination may initiate violent polymerization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with methyl acrylate liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully encapsulating suits made of compatible material are appropriate for most large spill situations. Butyl rubber and neoprene have been reported as appropriate materials of construction.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

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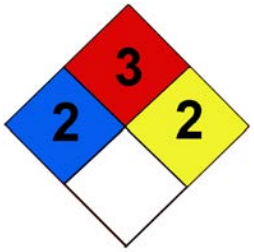
METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or burns to skin, eyes and respiratory tract. Irritation or burns to mouth throat and stomach, gastrointestinal distress, nausea, vomiting, dizziness and difficulty breathing in cases involving accidental ingestion.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure. This may result in increased respiratory distress with time. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists or exposure is severe.

First Aid for Ingestion: Do not induce vomiting. If victim is conscious, administer large quantities of water or milk. Never give anything by mouth to an unconscious person. Seek medical assistance immediately. Be alert to signs of difficulty in breathing, nervousness or other indications of systemic toxicity.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, compatible multi-purpose foam, carbon dioxide, or dry chemical extinguishing agents. Water as a direct stream may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with methyl acrylate. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if without risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Intact containers may rupture violently if exposed to heat due to runaway polymerization of methyl acrylate. Temperatures above 38.8°C (100°F) may favor polymerization reaction. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water, from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water as a direct stream may be ineffective. Carbon dioxide or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing, system. Alcohol foam is appropriate for fires involving methyl acrylate.

SPILL RESPONSES

General Information: Methyl acrylate is a severe polymerization hazard when inhibitor is exhausted or in high temperature conditions. It is flammable and toxic. Response strategies should account for the fact that flammable vapors are heavier than air and may collect locally in enclosed spaces or low lying areas. Flammable vapors may travel a considerable distance to source of ignition and flash back to source. When spilled in water, methyl acrylate is only slightly soluble and will tend to float on the water's surface. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of methyl acrylate may result in explosion.

METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl acrylate spills may expose downwind areas to toxic or flammable concentrations over considerable distances, in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog applied to methyl acrylate vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain a small amount (if any) of methyl acrylate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of methyl acrylate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with methyl acrylate.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of methyl acrylate liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Methyl acrylate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to intercept leaking methyl acrylate.

CONSEQUENCE

Methyl acrylate may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Methyl acrylate is highly flammable and explosion proof (intrinsically safe) equipment must be used.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION . . . Spilled methyl acrylate can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbents.

CONSEQUENCE

Sorbents will become contaminated with methyl acrylate and will pose the same hazards as the spilled product. Use of sorbents will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbents to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with methyl acrylate may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines. Explosion proof (intrinsically safe) equipment must be used due to the high flammability of methyl acrylate.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Removed materials may pose a continued risk of fire or contamination.

MITIGATION

Decontaminate all equipment after use, with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

METHYL ACRYLATE, INHIBITED
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible materials may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 - 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of the spilled methyl acrylate.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT/DIVERSION . . . Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating methyl acrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose a hazard to future users. Fire hazards pose risk to personnel and equipment.

MITIGATION

Decontaminate equipment after use. Store recovered methyl acrylate in a safe and secure location. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with methyl acrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of the contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in a proper and safe manner. Use compatible equipment. Eliminate ignition sources.

METHYLAMINE, ANHYDROUS

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Methylamine is a colorless gas with a fishy odor at lower concentrations and an ammonia-like or suffocating odor at higher concentrations. It is used mainly as an intermediate in organic synthesis but also has other uses such as an intermediate for water gel explosives, accelerators, pharmaceuticals, insecticides, in tanning, component of photographic developers, paint removers, fuel additive, production of dyes, polymerization inhibitor and rocket propellant. It is produced from methanol and ammonia in the presence of an Al_2O_3 catalyst at 450°C (842°F). The resultant mix of mono-, di-, and tri- methylamines is separated by distillation under pressure. It is very soluble in water, of which the resultant pH is basic at 11.8, as well as being soluble in alcohol, ethanol, acetone, diethyl ether and benzene. It is normally stable although it may react with strong acids, oxidizing agents, halogens and some other materials. It is corrosive to aluminum, copper, copper alloys, zinc alloys, and galvanized surfaces.

Methylamine is a very flammable gas with a lower explosive limit of 4.9% and an upper explosive limit of 20.7%. During a fire, toxic nitrogen oxide gases may be generated. Flame is nearly invisible in daylight. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Hazardous decomposition products include carbon dioxide, carbon monoxide, nitrogen oxides, ammonia and traces of organic compounds including hydrogen cyanide, nitriles, isocyanates, nitrosamines and amines.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very soluble (108 g/ml at 25°C (77°F))
Solubility in Other Chemicals: Soluble in alcohol, ethanol, acetone, diethyl ether and benzene. Miscible with ether.
Specific Gravity (Water=1): .693 at -6.5°C (20°F)
Vapor Density (Air=1): 1.07
Boiling Point: -6.3°C (20.7°F)
Freezing Point: -93.5°C (-136.3°F)
Molecular Weight: 31.07
Heat of Combustion: -8340 cal/g
Vapor Pressure: 300 pKa (2.96 atm) (27 psi) at 20°C (68°F); 2622 mm Hg at 25°C (77°F); approximately 760 pKa (7.5 atm) at 50°C (122°F)
Flash Point: -17.8°C (0°F)
Autoignition Temperature: 430°C (806°F)
Burning Rate: Rapid
Flammable Limits: 4.9% (LEL) - 20.7% (UEL)
Stability: Stable
Polymerization Potential: Will not occur.
pH: 11.8 (.1 M solution) (calculated)
Corrosiveness: Corrosive to aluminum, copper, copper alloys, zinc alloys and galvanized surfaces. May attack some forms of plastics, rubber and coatings.
Reactivity and Incompatibility: May react with strong acids, oxidizing agents and halogens. Calcium hypochlorite and sodium hypochlorite react to form normal chloroamines, which are explosive. Mercury reacts to form shock sensitive compounds. Nitromethane reaction products may detonate. Nitrosyl perchlorate mixtures can explode. Violent reaction may result when mixed with oxidizing agents like peroxides, permanganate, etc.

IDENTIFICATION

Shipping Name(s): Methylamine, anhydrous (USDOT & IMO)
Synonyms and Tradenames: Aminomethane; Carbinamine; Methanamine (9Cl); Methylamine; Methylamine, anhydrous; Mercurialin; MMA; Monomethylamine
CAS Registry No: 74-89-5
Chemical Formula: CH_3NH_2
Constituent Components (% each): Greater than 98% pure.
UN/NA Designation: UN1061
IMO Designation: 2.1
RTECS Number: PF6300000
NFPA 704 Hazard Rating: 3 (Health): 4 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquefied compressed gas
Physical Form as Released: Fuming liquid or gas
Color of the Shipped Material: Colorless
Odor Characteristics: Characteristic fishy odor at lower concentrations and an ammonia-like or suffocating odor at high concentrations (100-500 ppm).
Reportable Quantity: See appendix I
Common Uses: Used mainly as an intermediate in organic synthesis, as an intermediate for water gel explosives, accelerators, pharmaceuticals, insecticides, N-methylpyrrolidine, methylalkanolamines, surface active agents, fungicides, in tanning, component of photographic developers, paint removers, fuel additive, production of dyes, polymerization inhibitor and rocket propellant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHYLAMINE, ANHYDROUS

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 4.7 ppm (detection); wide range reported from .0009-4.68 ppm. Olfactory fatigue may occur.

Unusual Hazards: Extremely flammable with relatively wide range of flammability. Very toxic and may be fatal if inhaled in large concentrations and harmful if swallowed. Extremely irritating to the respiratory tract and may cause delayed lung injury. Low concentrations of amines may cause a temporary visual disturbance known as “blue haze” or “halo vision”. Frostbite like burns may occur from contact with liquid or concentrated cold gas.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 10 ppm

Ceiling (C) Limit: Unavailable

IDLH: 100 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong acids, oxidizing agents, mercury, nitromethane and halogens. Corrosive to aluminum, copper, copper alloys, zinc alloys and galvanized surfaces.

HEALTH HAZARDS

Potential Health Hazards: Material may cause burns or ulceration to the skin. Eye contact can cause irritation. High vapor concentrations can cause corneal opacity or eye corrosion with corneal or conjunctival ulceration. Inhalation can cause irritation of the respiratory tract. Ingestion can cause gastrointestinal irritation. Individuals with preexisting lung disorders or skin disorders may have increased susceptibility to this material.

Hazards of Skin or Eye Contact: Material is corrosive and can cause redness, pain and inflammation. Contact with liquid or concentrated cold gas can cause frostbite like burns with symptoms ranging from numbness, prickling, itching, burning and/or stiffness. Tissue can become discolored and appear white to yellow. In severe cases, blistering, tissue death and gangrene may occur. Brief exposure to the eyes can cause irritation such as redness and tearing. Longer exposure can lead to inflammation of the eyes leading to blurred vision. Liquid or concentrated cold gas may cause freezing or clouding of the cornea leading to loss of sight. Permanent eye damage or blindness can result. Conditions known as “blue haze” or “halo vision” from exposure to amines is known to exist and usually clears up within a day, although it is not known whether methylamine can cause this condition

Hazards of Inhalation: Material is severely irritating to the respiratory tract. Symptoms of brief exposure are irritation and burning of the nose and throat. Symptoms of exposure to higher concentrations can include coughing, wheezing, headache, nausea, faintness, vomiting, diarrhea, abdominal cramps and feelings of anxiety. Symptoms disappear when exposure stops. In severe cases, death can result from inflammation of the bronchi and lungs and fluid accumulation in the lungs known as pulmonary edema. Symptoms of pulmonary edema can develop several hours after exposure and are aggravated by physical exertion.

Hazards of Ingestion: Ingestion is unlikely due to physical nature of methylamine as a gas, but can cause severe gastrointestinal irritation severe gastrointestinal irritation, nausea, vomiting or burns. It can also cause frost like symptoms.

FIRE HAZARDS

Lower Flammable Limit: 4.95%

Upper Flammable Limit: 20.75%

Behavior in Fire: Material is extremely flammable with a wide range of flammability. Aqueous solution of 5% or greater are still flammable. During a fire, toxic nitrogen oxide gases may be generated. It will readily ignite if exposed to sources of heat and flame. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Containers exposed to prolonged heat or fire may violently rupture.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, nitrogen oxides, ammonia and traces of organic compounds including hydrogen cyanide, nitriles, isocyanates, nitrosamines and amines.

EXPLOSION HAZARDS

Explosive Potential: High. Can readily form explosive mixtures with air. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged heat or fire may violently rupture.

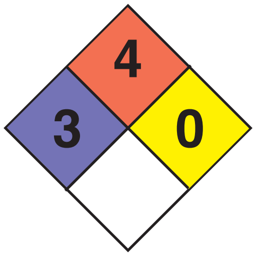
PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level

1061

METHYLAMINE, ANHYDROUS

Division 2.1 (Flammable Gas)



A Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product. Suitable materials of construction are: butyl rubber, nitrile rubber, Tychem® 10,000 and Viton®(longer than 8 hours); neoprene (longer than 4 hours), polyvinylchloride, 4H® (1 to 4 hours); and, Barricade®, Tychem® 9400 (105 minutes). Natural rubber, Chemrel® and polyvinylalcohol have less than 1 hour resistance to breakthrough and are not recommended for use. Structural firefighting protective clothing will not provide an adequate level of personal protection for this product.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved full-facepiece chemical cartridge respirator with cartridge, gas mask with canister, powered air-purifying respirator with cartridge should provide adequate protection for post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

FIRST AID

Nonspecific Symptoms: Symptoms of skin contact can include redness, pain, inflammation and frostbite. Eye contact can cause irritation, inflammation, blurred vision and even loss of vision. Inhalation can cause severe respiratory irritation; symptoms of exposure to higher concentrations can include coughing, wheezing, headache, nausea, faintness, vomiting, diarrhea, abdominal cramps and feelings of anxiety. In severe conditions, pulmonary edema can result. Although ingestion is unlikely, symptoms are irritation of the nose, throat, esophagus and stomach.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Do not allow patient to move if not necessary, pulmonary edema symptoms can be delayed up to 48 hours. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact, flush with lukewarm water until chemical is removed. In cases of frostbite, do not attempt to rewarm the affected area on site without medical advice. Remove contaminated clothing, if clothing is stuck to an affected area gently cut around affected area and remove rest of garment. Loosely cover the affected area with a sterile dressing. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water for 15 minutes while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large quantities of water, milk or activated charcoal slurry if victim is conscious but do not induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Special Note to Physicians: To prepare activated charcoal slurry, suspend 50 grams of activated charcoal in 400 ml of water and shake well. Give 5 ml/Kg of body weight or 350 ml for an average adult.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam, or water spray (fog).

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Solid streams of water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

METHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

SPILL RESPONSES

General Information: Methylamine is a highly flammable and corrosive gas that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

MONITOR THE SITUATION . . . With a boiling point of -6.3°C (21°F) flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG . . . Water sprays may be used to reduce vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

METHYLAMINE, ANHYDROUS

Division 2.1 (Flammable Gas)

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents may be applied to the surface of liquid pools to reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid may slow the release of vapors into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

METHYLAMINE, ANHYDROUS
Division 2.1 (Flammable Gas)

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor for flammable conditions.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water via a processing system constructed on land.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

METHYLAMINE, AQUEOUS SOLUTION

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methylamine is a colorless liquid with a fishy odor at lower concentrations and an ammonia-like or suffocating odor at higher concentrations. It is used mainly as an intermediate in organic synthesis but also has other uses such as an intermediate for water gel explosives, accelerators, pharmaceuticals, insecticides, in tanning, component of photographic developers, paint removers, fuel additive, production of dyes, polymerization inhibitor and rocket propellant. It is produced from methanol and ammonia in the presence of an Al_2O_3 catalysts at 450°C (842°F). The resultant mix of mono-, di-, and tri- methylamines is separated by distillation under pressure. It is very soluble in water, of which the resultant pH is basic at 11.8, as well as being soluble in alcohol, ethanol, acetone, diethyl ether and benzene. It is normally stable although it may react with strong acids, oxidizing agents, halogens and some other materials. It is corrosive to aluminum, copper, copper alloys, zinc alloys, and galvanized surfaces.

Methylamine is very flammable, with a lower explosive limit of 4.9% and an upper explosive limit of 20.7%. During a fire, toxic nitrogen oxide gases may be generated. Flames from methylamine are nearly invisible in daylight. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Hazardous decomposition products include carbon dioxide, carbon monoxide, nitrogen oxides, ammonia and traces of organic compounds including hydrogen cyanide, nitriles, isocyanates, nitrosamines and amines.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very soluble

Solubility in Other Chemicals: Soluble in alcohol, ethanol, acetone, diethyl ether and benzene. Miscible with ether.

Specific Gravity (Water=1): .902 at 20°C (68°F) (40% sol.)

Vapor Density (Air=1): 1.07

Boiling Point: 48°C (118°F) (40% solution)

Melting Point: -39°C (-38°F)

Freezing Point: Unavailable

Molecular Weight: 31.07

Heat of Combustion:

Vapor Pressure: 236 mmHg (40% solution); 569 mmHg (50% solution) at 20°C

Evaporation Rate: Unavailable; probably rapid.

Flash Point: -10 °C (14°F), (closed cup), (40% solution); -34°C (-29°F) (50% solution)

Autoignition Temperature: 430°C (806°F)

Burning Rate: Unknown

Flammable Limits: 4.9% (LEL) - 20.7% (UEL)

Stability: Stable

Polymerization Potential: Will not occur.

pH: 11.8 (.1 M solution) (calculated)

Corrosiveness: Corrosive to aluminum, copper, copper alloys, zinc alloys and galvanized surfaces. May attack some forms of plastics, rubber and coatings.

Reactivity and Incompatibility: May react with strong acids, oxidizing agents and halogens. Calcium hypochlorite and sodium hypochlorite react to form normal chloroamines, which are explosive. Mercury reacts to form shock sensitive compounds. Nitromethane reaction products may detonate. Nitrosyl perchlorate mixtures can explode. Violent reaction may result when mixed with oxidizing agents like peroxides, permanganate, etc.

IDENTIFICATION

Shipping Name(s): Methylamine, aqueous solution (USDOT & IMO)

Synonyms and Tradenames: Aminomethane; Carbinamine; Melamine, solution aqueous; Methanamine; Methylamine; MMA; Monomethylamine

CAS Registry No: 74-89-5

Chemical Formula: CH_3NH_2 in H_2O

Constituent Components (% each): Commercially available as solutions of methylamine gas in water (30-50% by weight).

UN/NA Designation: UN1235

IMO Designation: 3.2

RTECS Number: PF6300000

NFPA 704 Hazard Rating: 3 (Health): 4 (Flammability): 0 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Characteristic fishy odor at lower concentrations and an ammonia-like or suffocating odor at high concentrations (100-500 ppm).

Reportable Quantity: See appendix I

Common Uses: Used mainly as an intermediate in organic synthesis, as an intermediate for water gel explosives, accelerators, pharmaceuticals, insecticides, surface active agents, fungicides, in tanning, component of photographic developers, paint removers, fuel additive, production of dyes, and polymerization inhibitor.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHLAMINE, AQUEOUS SOLUTION

Class (Flammable liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 4.7 ppm (detection); wide range reported from .0009-4.68 ppm. Olfactory fatigue may occur.

Unusual Hazards: Highly flammable with wide range of flammability. Material is very toxic and may be fatal if inhaled in large concentrations and harmful if swallowed. Extremely irritating to the respiratory tract and may cause delayed lung injury. Low concentrations of amines may cause a temporary visual disturbance known as “blue haze” or “halo vision”. Material is corrosive to tissue.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 10 ppm

Ceiling (C) Limit: Unavailable

IDLH: 100 ppm

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong acids, oxidizing agents, mercury, nitromethane and halogens. Corrosive to aluminum, copper, copper alloys, zinc alloys and galvanized surfaces.

HEALTH HAZARDS

Potential Health Hazards: Material may cause burns or ulceration to the skin. Eye contact can cause irritation; higher concentrations can cause corneal opacity or eye corrosion with corneal or conjunctival ulceration. Inhalation can cause irritation of the respiratory tract. Ingestion can cause gastrointestinal irritation. Individuals with preexisting lung disorders or skin disorders may have increased susceptibility to this material.

Hazards of Skin or Eye Contact: Material is corrosive and can cause redness, pain and inflammation. Tissue can become discolored and appear white to yellow. In severe cases, blistering, tissue death and gangrene may occur. Brief exposure to the eyes can cause irritation such as redness and tearing. Longer exposure can lead to inflammation of the eyes leading to blurred vision. Liquid may cause clouding of the cornea leading to loss of sight. Permanent eye damage or blindness can result. Conditions known as “blue haze” or “halo vision” from exposure to amines is known to exist and usually clears up within a day, although it is not known whether methylamine can cause this condition

Hazards of Inhalation: Material is severely irritating to the respiratory tract. Symptoms of brief exposure are irritation and burning of the nose and throat. Symptoms of exposure to higher concentrations can include coughing, wheezing, headache, nausea, faintness, vomiting, diarrhea, abdominal cramps and feelings of anxiety. Symptoms disappear when exposure stops. In severe cases, death can result from inflammation of the bronchi and lungs and fluid accumulation in the lungs known as pulmonary edema. Symptoms of pulmonary edema can develop several hours after exposure and are aggravated by physical exertion.

Hazards of Ingestion: Ingestion can cause severe gastrointestinal irritation, nausea, vomiting or burns.

FIRE HAZARDS

Lower Flammable Limit: 4.95%

Upper Flammable Limit: 20.75%

Behavior in Fire: Material is flammable and will very likely ignite if exposed to sources of heat. Aqueous solutions of 5% or greater are still flammable. During a fire, toxic nitrogen oxide gases may be generated. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Flame is nearly invisible in daylight. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Runoff may be flammable and/or toxic. Containers exposed to prolonged heat and flame may violently rupture.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, nitrogen oxides, ammonia and traces of organic compounds including hydrogen cyanide, nitriles, isocyanates, nitrosamines and amines.

EXPLOSION HAZARDS

Explosive Potential: Can form explosive mixtures with air. Can accumulate in confined spaces, resulting in an explosion or toxicity hazard. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Containers exposed to prolonged heat and flame may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

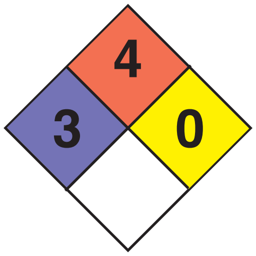
Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are: butyl rubber, nitrile rubber, Tychem® 10,000 and Viton®(longer than 8 hours); neoprene (longer than 4 hours); polyvinylchloride, 4H® (1 to 4 hours); and, Barricade® and Tychem® 9400 (254 minutes; 40% solution). Natural rubber, Chemrel® and polyvinylalcohol have less than 1 hour resistance to breakthrough and are not recommended for use. Structural firefighting protective clothing will not provide an adequate level of personal protection for this product.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

1235

METHLAMINE, AQUEOUS SOLUTION

Class (Flammable liquid)



FIRST AID

Nonspecific Symptoms: Symptoms of skin contact can include redness, pain, and inflammation. Eye contact can cause irritation, inflammation, blurred vision and even loss of vision. Inhalation can cause severe respiratory irritation; symptoms of exposure to higher concentrations can include coughing, wheezing, headache, nausea, faintness, vomiting, diarrhea, abdominal cramps and feelings of anxiety. In severe conditions, pulmonary edema can result. Although ingestion is unlikely, symptoms are irritation of the nose, throat, esophagus and stomach.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Do not allow patient to move if not necessary, pulmonary edema symptoms can be delayed up to 48 hours. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact, flush with plenty of soap and water for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, give large quantities of water or activated charcoal slurry but do not induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Special Note to Physicians: To prepare activated charcoal slurry, suspend 50 grams of activated charcoal in 400 ml of water and shake well. Give 5 ml/Kg of body weight or 350 ml for an average adult.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam or water spray (fog).

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Solid streams of water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Methylamine is a highly flammable and corrosive liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

METHLAMINE, AQUEOUS SOLUTION
Class (Flammable liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

MONITOR THE SITUATION . . . Depending on the concentration of the methylamine solution, the vapor pressure could be low and the boiling point high enough that hazardous vapor concentrations should not occur beyond the immediate spill area. However, continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapor, especially if a large spill and fire is involved.

CONSEQUENCE

If spill is large, hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low laying and enclosed areas.

MITIGATION

Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. If conditions warrant, evacuate the immediate area and downwind of the site of the release and to allow vapors to dissipate. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG . . . Water sprays may be used effectively to control the production of vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents may be applied to the surface of liquid pools to slow the release of methylamine vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid may slow the release of vapors into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

METHLAMINE, AQUEOUS SOLUTION

Class (Flammable liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where material is likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering sewers, waterways and storm drains. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for the presence of flammable vapors.

METHLAMINE, AQUEOUS SOLUTION

Class (Flammable liquid)

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water via a processing system constructed on land.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

METHYL BROMIDE

Class 2.3 (Poison Gas)

GENERAL INFORMATION

Methyl bromide is a colorless relatively odorless poison gas shipped as a liquid under pressure and used as a fumigant, in food sterilization, as a solvent, as a refrigerant, and for making other chemicals. It is heavier than and slightly soluble in water. Its boiling point of approximately 38.4°F indicates it will boil or rapidly vaporize under most ambient temperature conditions, thus evolving a large amount of vapor or gas that is heavier than air and may persist in pits, hollows, and depressions. Although it is considered practically nonflammable and has been used on occasion as a fire extinguishing agent, methyl bromide can be ignited with a high energy source of ignition. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. There is also a potential for accumulations of vapor in confined spaces such as buildings or sewers to result in explosions if a suitable ignition source is present. Liquid methyl bromide weighs approximately 14 pounds per gallon.

Methyl bromide is stable in normal transportation. It does not react with water or many common materials but may react with a variety of other chemicals including strong oxidizers and is incompatible with magnesium, aluminum, and their alloys. Reactions with dimethyl sulfoxide, alkali and alkaline earth elemental metals, certain other metals, peroxides, and strong reducing agents may be explosive. The product is highly toxic by all routes of exposure. Products of combustion may include highly toxic fumes.

If methyl bromide is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 900 mg/l at 68°F (20°C)

Solubility in Other Chemicals: Mixes with most organic solvents; alcohol, ether, chloroform, carbon disulfide, benzene, and carbon tetrachloride.

Specific Gravity (Liquid): 1.68 at 68°F (20°C)

Boiling Point: 38.3 – 38.5 °F (3.5 - 3.6°C) at 1 atm.

Melting Point: –136.5 to –136.7°F (– 93.6 to – 93.7°C)

Freezing Point: –135°F (– 93°C)

Molecular Weight: 94.94

Heat of Combustion: –1771 cal/g

Vapor Pressure: 2 atm (29.4 psia) at 73.9°F (23.3°C)

Flash Point: Unavailable; practically nonflammable

Autoignition Temperature: 999°F (537°C)

Burning Rate: Not pertinent

Stability: Stable

Corrosiveness: Attacks aluminum (forming spontaneously combustible aluminum alkyls), magnesium, and the alloys of these metals. May also attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with aluminum, dimethyl sulfoxide, mineral acids, amines, strong oxidizing agents, caustics, nitrides, alkali or alkaline earth elemental metals, other metals, organic peroxides or hydroperoxides, strong reducing agents, azo and diazo compounds and hydrazines.

IDENTIFICATION

Shipping Names: Methyl bromide (USDOT & IMO)

Synonyms and Tradenames: Bromomethane; Brom-o-Gas; Bromosol; Brozone; Celfume; Dowfume; Edco; Embafume; Fumigant-1; Halon 1001; Iscobrome; Kayafume; MB; MBX; M-B-C Fumigant MEBR; Metafume; Methogas; Monobromomethane; Pestmaster; Profume; Rotex; Terr-o-gas 100; Zytox

Chemical Formula: CH_3Br

Constituent Components(% each): Technical, pure (99.5% min), or less than 2% chloropicrin in liquid methyl bromide; commercial mixtures may include chloropicrin, ethylene dibromide, or nonflammable compressed gas in varying amounts.

UN/NA Designation: UN1062

IMO Designation: 2.3, poison gas

Physical Shte as Shipped: Liquefied gas

Physical State as Released: Gas, boiling liquid, or evaporating liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Like chloroform; sweet; relatively odorless except at higher levels, but chloropicrin may produce sharp, penetrating odor if present.

Common Uses: Soil and space fumigant; solvent; herbicide; refrigerant; raw material for organic chemical mfg.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYL BROMIDE

Class 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Methyl bromide boils or rapidly vaporizes upon release to produce large amounts of toxic vapors and gases that are heavier than air. The product may be absorbed through the skin in toxic amounts. Vapors may persist in pits, hollows, and depressions.

Short Term Exposure Limits(STEL): (Skin) 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 5 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Inhalation or physical contact; strong ignition sources; water contamination; incompatible materials.

HEALTH HAZARDS

Public Health Hazards: Major hazard to the public is via inhalation of vapors in air since the vapor cloud or plume from a spill may expose the public to toxic levels over considerable distances. Also of concern are burns or toxic effects due to physical contact with liquid methyl bromide and ingestion of contaminated water supplies.

Hazards of Skin or Eye Contact: Methyl bromide can be absorbed through the skin in toxic amounts. Liquid splashed on clothing or leather and held in contact with skin may cause skin burns with large blisters appearing after several hours. Less severe exposures may cause itching skin rash after several days. Contact of liquid with eyes may cause irritation and/or severe but usually reversible injury involving temporary blindness.

Hazards of Inhalation: Breathing methyl bromide may cause headache, dizziness, nausea, vomiting, blurred vision, slurred speech, tremors, and convulsions. High concentrations may cause lung irritation, permanent nervous system injury, kidney damage, unconsciousness and possibly death. Onset of toxic symptoms may be delayed from 30 minutes to several days. Lung effects may include pulmonary edema.

Hazards of Ingestion: Methyl bromide is a strong irritant and highly toxic poison if ingested.

FIRE HAZARDS

Lower Flammable Limit: 10% (or 13.5%)

Upper Flammable Limit: 14.5-16%

Behavior in Fire: Practically nonflammable liquefied gas. Will burn but very difficult to ignite. Containers may rupture violently in fire due to overpressure.

Haardous Combustion Products: Highly toxic fumes are produced in fires.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Practically nonflammable but containers may rupture violently in fire due to overpressure. Contact with certain other substances may result in formation of explosive mixtures. See General Information section.

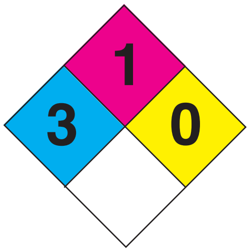
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact or any reasonable probability of eye contact with liquid methyl bromide or its concentrated vapors or fumes. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1062

METHYL BROMIDE
Class 2.3 (Poison Gas)



FIRST AID

Nonspecific symptoms: Headache, dizziness, nausea, vomiting, and other effects of inhalation. Eye or skin irritation or burns from direct contact. Symptoms may be delayed.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, foam, carbon dioxide, dry chemical.

Extinguishing Techniques: Unusual toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Eliminate ignition sources. Use explosion-proof equipment where necessary. Choose equipment that is not attacked or otherwise damaged by the spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Take into account when planning the response that methyl bromide is highly toxic and boils or rapidly evaporates in the open environment. Vapors may persist in pits, hollows, and depressions. Reactions with aluminum form spontaneously combustible compounds.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl bromide spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl bromide vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point downwind of the spill. Do not get water on liquid pools of methyl bromide as this may accelerate vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of methyl bromide from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

METHYL BROMIDE
Class 2.3 (Poison Gas)

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of methyl bromide vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. It is possible that vapor generation will temporarily increase during initial stages of foam application. Proceed with caution. Consult qualified experts.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if the response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methyl bromide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained methyl bromide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

METHYL BROMIDE
Class 2.3 (Poison Gas)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

CONTAINMENT . . . Spilled product may sink in water and exist as slowly dissolving liquid on bottom when released at sufficient depth under water or when water is very cold. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery. Equipment should be of adequate pressure capacity.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

March 1995

METHYL tert-BUTYL ETHER

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl tert-butyl ether is a colorless, volatile, and flammable liquid with an odor that has variably been described as unpleasant, like a pleasant hydrocarbon, mint-like, or resembling terpene. The product is fairly soluble in water and lighter, so can be expected to dissolve at an appreciable rate while also evaporating from the water surface. Its boiling point of approximately 131°F and lowest reported flash point of 18.4’F indicate that methyl tert-butyl ether is easily ignited under virtually all ambient temperature conditions. Vapors of methyl tert-butyl ether are heavier than air, may travel a considerable distance to a source of ignition and flash back, and/or may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.2 pounds per gallon.

Methyl tert-butyl ether does not react with water or many other common materials and is considered stable in normal transportation. It is reported as incompatible with strong oxidizing agents, caustics, strong acids, amines, alkanolamines, aldehydes, ammonia, and chlorinated compounds. It should be especially noted that a similar ether reacts violently, forms an explosive mixture, and/or spontaneously explodes in contact with a wide variety of strong oxidizing agents. Additionally, it should be appreciated that some ethers are known to form unstable and explosive peroxides upon prolonged storage and/or when exposed for a time to heat, air and/or light. Although there is evidence that methyl tert-butyl ether requires several years to form unstable peroxides in normal storage, it is prudent to recognize the potential hazards associated with this phenomena under abnormal emergency conditions.

Methyl tert-butyl ether is not expected to be corrosive to common metals but may attack some types of plastic and rubber. Toxicity of the substance is generally low. Products of combustion may include toxic constituents.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if methyl tert-butyl ether is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Partially soluble; 48,000 ppm at 68°F (20°C); equal to about 5.042 g/100 g water at this temperature.

Solubility in Other Chemicals: Soluble in alcohol and ether

Specific Gravity (Liquid): 0.740-0.741 at 68°F (20oC)

Boiling Point: 131-131.4°F (55-55.2°C) at 1 atm.

MeltingPoint: –166.0 to –163.5°F (–110 to –108.6°C)

Freezing Point: See melting point

Molecular Weight: 88.15

Heat of Combustion: About 8400 cal/g

Vapor Pressure: 240 mm Hg (4.639 psia) at 68°F (20°C); 313 mm Hg (6.050 psia) at 86°F (30°C); 414 mm Hg (8.002 psia) at 100°F (38°C)

Flash Point: –18.4 to –16.6°F (–28 to –27°C) by Tag closed-cup and Abel-Pensky methods

Autoignition Temperature: 815°F (435°C) or 379°F (193°C); reported values vary widely

Burning Rate: Not available

Stability: Stable in normal transportation.

Corrosiveness: Similar ethers are generally noncorrosive to metals but may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Methyl tert-butyl ether is simply reported to be incompatible with strong oxidizing agents, caustics, strong acids, amines, alkanolamines, aldehydes, ammonia, and chlorinated compounds.

IDENTIFICATION

Shipping Names: methyl tert-butyl ether (USDOT and IMO).

Synonyms and Tradenames: tert-Butoxymethane; tert-butyl methyl ether; 2-methoxy-2-methylpropane; methyl 1,1-dimethylethyl ether; 2-methyl-2-methoxypropane; 2,2-methylmethoxypropane; (2-methyl-2-propyl) methyl ether; 2,2-MMOP; MTB; MTBE; propane, 2-methoxy-2-methyl.

Chemical Formula: $(CH_3)_3COCH_3$

Constituent Components (% each): Limited data available; commercial products appear to be relatively pure.

UN/NA Designation: UN2398

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid (boils at about 131°F)

Color of the Shipped Material: Clear and colorless

Odor Characteristics: Variably described as pleasant hydrocarbon odor; unpleasant; mint-like; or resembling terpene.

Common Uses: Used as ingredient of unleaded gasoline to boost octane (typically 2 to 8 concentration by weight in gasoline, but permitted as high as 11%); also used to make isobutene.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYL tert-BUTYL ETHER

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available

Unusual Hazards: Volatile and flammable liquid with heavier than air vapors that may persist in low areas. Some information implies the product may be sensitive to ignition by static electricity. See discussions above and below about the possibility of potentially explosive peroxide formation.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; extended storage; exposure to air and/or light.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from prolonged inhalation of the very high vapor concentrations that may be present in air in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided. Note that overexposure to a similar ether has been reported to increase the severity of effects related to drinking alcoholic beverages. It is not known whether this will occur upon exposure to methyl tert-butyl ether.

Hazards of Skin or Eye Contact: Brief contact of exposed skin with liquid methyl tert-butyl ether is expected to cause little or no irritation. Repeated or prolonged skin contact with the liquid may result in drying and cracking of the skin due to the defatting action of the product. Some degree of local edema, redness, and death of skin tissue may also occur as the result of excessive exposures. Contact of the eyes with the liquid is simply reported to cause irritation. By analogy to a similar ether, it is presumed that a transitory smarting sensation and slight but reversible eye injury are the most likely outcomes of eye contact. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Vapors of methyl tert-butyl ether are generally of low toxicity in acute exposures. High concentrations in air may cause irritation of the eyes, nose, throat, and respiratory tract. Based on animal experiments, inhalation of very high concentrations is expected to cause narcosis and central nervous system depression with symptoms including dizziness, headache, sleepiness, incoordination, irregular respiration, prostration, hyperemia (i.e., excess of blood, engorgement) in the lungs, unconsciousness, and possibly death due to respiratory system failure in extreme cases. Similar ethers have been found to cause additional symptoms in humans such as excitement, stupor, nausea, vomiting, paleness, lowering of the pulse and body temperature, muscular relaxation, excessive salivation, weakness, irregular heartbeat, and possibly jaundice, liver damage, and/or kidney damage. The lowest concentration of methyl tert-butyl ether reported to kill 50 of rats in laboratory experiments was about 23,575 ppm in four-hour exposures. Data are not available for exposures of shorter duration. Note that the saturated vapor concentration of the product in air is about 315,800 ppm directly over the surface of liquid pools at 68°F and will drop off rapidly with distance.

Hazards of Ingestion: The single-dose oral toxicity of methyl tert-butyl ether is generally low. Ingestion of relatively significant quantities is expected to result in depression of the central nervous system and symptoms which may include lachrymation, dizziness, muscular weakness, diminished activity, incoordination, tremors, labored breathing, inflammation of the stomach and/or small intestine, prostration, and possibly death in extreme cases. Other symptoms associated with inhalation may also be possibly observed. The oral LD60 for rats, the dose which proves fatal to 50 of the animals, is reported as approximately 3.9 g/kg of body weight. Overall, fatal oral doses for rats are reported to range from 2.9 to 4.8 g/kg of body weight.

FIRE HAZARDS

Lower Flammable Limit: 1.65%, 2%, or 2.5%; reported values vary but 2% appears to be preferred by most.

Upper Flammable Limit: Most references say 15.1% but one maker of the product lists a value of 8.4%.

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in a fire and possibly rocket. Although not reported as a hazard for methyl tert-butyl ether specifically, be advised that the heat from a nearby fire has been presumed to possibly promote formation of unstable explosive peroxides in similar ethers.

Hazardous Combustion Products: Not well-defined; include carbon monoxide, carbon dioxide, and possibly other toxic constituents. One authority reports that acrid smoke and fumes are generated upon thermal decomposition of methyl tert-butyl ether.

2398

METHYL tert-BUTYL ETHER

Class 3 (Flammable Liquid)

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire and possibly rocket. Contact with strong oxidizing agents may potentially cause an explosion. Exposure to heat, air, and/or light may produce unstable and explosive peroxides with time in various ethers. Although there are indications that methyl tert-butyl ether does not readily form such peroxides in normal storage, it is best to be aware of this possibility under emergency conditions.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. One maker of methyl tert-butyl ether indicates that buna-n provides generally acceptable chemical resistance to the product. Clothing materials listed as potentially compatible by various authorities for generally similar ethyl ether (also known as diethyl ether) include chlorinated polyethylene, polyvinyl alcohol, Teflon, Silvershield, neoprene/styrene-butadiene rubber, butyl rubber, nitrile rubber, polyethylene, and polyurethane. The specific resistance of these materials to methyl tert-butyl ether cannot be confirmed.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; symptoms of narcosis or central nervous system depression.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water if the ether has not already evaporated. Get medical attention if eye or skin irritation persists after washing.
First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately. (Note: This recommendation is from a maker of the product and a product distributor who are consistent in their advice. Be advised, however, that authorities disagree on whether saltwater should be administered to conscious victims and vomiting be induced in cases involving the generally similar diethyl ether, also known as ethyl ether. To be safe, it is advised that immediate and qualified medical advice be obtained on this issue if possible when necessary, realizing that either course of action is likely to entail risks to the victim. If vomiting occurs naturally or otherwise, have the victim lean forward and keep head below hips to reduce risk of aspiration of liquid into the lungs.)

FIRE RESPONSE

Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective, but very large quantities (at ratios of more than 20:1 water to ether; no less) may possibly be used to dilute a spill to a nonflammable mixture. (Note: Authorities are divided on whether alcohol or standard foam should be used. It is possible that both types are suitable to some degree. Be advised that one reference indicates that this product has been reported to be difficult to extinguish with a foam of unspecified type because "no film-forming effect is shown".)
Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may rupture violently, suddenly release massive amounts of product, and possibly rocket when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

METHYL tert-BUTYL ETHER
Class 3 (Flammable Liquid)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of methyl tert-butyl ether may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take the volatility and flammable nature of methyl tert- butyl ether into account when planning the response. Beware of possible heavy vapor accumulations in low areas. To be prudent with respect to the possibility of hazardous peroxide formation, avoid direct sunlight and exclude air from the recovered product if at all possible. Seek expert advice on appropriate disposal or treatment procedures.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors to dissipate. Methyl tert-butyl ether discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION . . . Due to its generally low inhalation toxicity, methyl tert-butyl ether discharges may not pose a significant toxic hazard to downwind populations in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, evaporates or is otherwise treated, especially when spills are small and flammability hazards are limited.

CONSEQUENCE

Hazardous levels of the ether may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl tert-butyl ether vapors in air may absorb some amount of the vapors and/or accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of the ether from contact with its vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of methyl tert-butyl ether vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution. Be advised that authorities are divided on whether alcohol or regular foam is more appropriate; it is possible that both are suitable to some degree. Note also that there are indications that some types of foam may not work well when applied to this product.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. If the foam is breaking down too rapidly, apply a different response technique.

METHYL tert-BUTYL ETHER
Class 3 (Flammable Liquid)

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid methyl tert-butyl ether may slow the release of vapors into the atmosphere. The amount of water must be sufficient to completely dissolve the ether or the response will not be effective. Thus, be prepared to add 20-25 times (or more) as much water by weight as the amount of ether that has spilled.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methyl tert-butyl ether may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material .

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, vermiculite, perlite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note than noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

METHYL tert-BUTYL ETHER
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammahle vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal. and public users to stop water intake or to monitor water for contamination. Note: Methyl tert-butyl ether is not only volatile in all but very cold weather but its solubility in water, though limited, is appreciable. Although some authorities may suggest the possibility of using oil spill type containment and cleanup techniques for spills on water, such techniques would only be suitable under relatively unusual conditions and are therefore not listed below. Also be advised that methyl tert-butyl ether is expected to have a significant and rapid tendency to volatilize fiom surface waters; one reference reports a half-life in surface water of only 9 hours under the conditions studied. However, the product imparts an odor to water at concentrations as extremely low as 20 to 50 parts per billion. The 96-hour LC^{50} for fathead minnows is 706 ppm in water; never the less, one authority reports that the product is expected to be of relatively low toxicity to aquatic life in short-term exposures.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained or diverted to impoundment area by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

METHYL CHLORIDE
Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Methyl chloride is a colorless gas shipped under pressure as a liquid and having a faintly sweet odor that resembles ether. It is used as a solvent, extractant and propellant, and for making a variety of other chemicals. Being slightly soluble in water, liquid spills on water will boil off rapidly with small amounts dissolving. All spills on land or water will evolve relatively large amounts of flammable and relatively toxic gases or vapors that are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of gas in confined spaces such as buildings or sewers may result in explosions if ignited, and there is an unconfirmed possibility of explosions involving unconfined vapor clouds. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 8.3 pounds per gallon near its boiling point temperature.

Methyl chloride does not react with water and is stable in normal transportation. It reacts with zinc, aluminum, magnesium, and the alloys of these metals, will attack some forms of plastics, rubber and coatings, and is otherwise reactive with various chemicals. Vapors are relatively toxic and may be present in air in high concentrations. Contact with the liquid or cold gas streams may result in frostbite. Products of combustion may include phosgene, hydrogen chloride, and other toxic and irritating gases.

Downwind evacuation should be considered if methyl chloride is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.6 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetic acid, acetone, alcohol, benzene, chloroform and ether.

Specific Gravity (Liquid): 0.997 at –11.2°F (–24°C); 0.916 at 68°F (20°C)

Boiling Point: –11.6°F (–24.2°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: –143.9°F (– 97.7°C)

Molecular Weight: 50.49

Heat of Combustion: –2939 cal/g

Vapor Pressure: 4.8 atm (70.5 psia) at 68°F (20°C)

Flash Point: Very low, flammable gas

Autoignition Temperature: 1170°F (632°C)

Burning Rate: 2.2 mm/minute

Stability: Stable

Corrosiveness: Reacts with zinc, aluminum, magnesium, and their alloys when dry, especially when they are powdered. May take on the reactivity of hydrochloric acid when wet. Will attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction, but slowly hydrolyzes to hydrochloric acid.

Reactivity with Other Chemicals: See corrosiveness section above. Also incompatible with die castings, potassium, sodium, and possibly other chemicals and materials.

IDENTIFICATION

Shipping Names: Methyl chloride (USDOT and IMO)

Synonyms and Tradenames: Chloromethane; Freon 40; monochloromethane; Artic.

Chemical Formula: CH_3C1

Constituent Components (% each): 99.5% pure

49 STCC: 49 057 61

UN/NA Designation: UN1063

IMO Designation: 2.3, poison gas

Physical State as Shipped: Liquefied gas

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Faint, sweet, pungent, like ether

Common Uses: Refrigerant; solvent in synthetic rubber industry; extractant for greases, oils, and resins; propellant; mfg. of fumigants, herbicides, drugs, and other chemicals.

METHYL CHLORIDE
Class 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10.1 ppm reported, but may be much higher
Unusual Hazards: Extremely volatile and flammable substance with heavier than air vapors that may persist in pits and depressions. May be hazardous over considerable downwind distances.
Short Term Exposure Limits (STEL): 100 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 50 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and downwind. Ingestion and physical contact are also to be avoided.
Hazards of Skin or Eye Contact: Contact of the skin with liquid methyl chloride or venting gas may result in frostbite. Contact with the eyes may cause temporary burns.
Hazards of Inhalation: High concentrations of methyl chloride in air may cause narcosis and a toxic encephalopathy with symptoms including dizziness, vomiting, abdominal pain, diarrhea, anemia, kidney or liver damage, vision disturbances, convulsions, nausea, weakness, slurred speech and confusion, cyanosis, paralysis, coma, and possibly death. Effects are usually delayed for several hours. Exposures to 3000 ppm in air for 7 hours was lethal to 50% of mice in laboratory experiments. Very high concentrations may also asphyxiate by displacement of air.
Hazards of Ingestion: Ingestion may cause frostbite of the mouth and throat, anorexia, nausea, vomiting, abdominal pain, diarrhea, jaundice, hepatomegaly, and splenomegaly.

FIRE HAZARDS

Lower Flammable Limit: 8.1–8.25%
Upper Flammable Limit: 17.2–18.7%
Behavior in Fire: Flammable liquefied gas. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.
Hazardous Combustion Products: May include phosgene, carbon monoxide, hydrogen chloride, and other toxic and irritating gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. By analogy to ethyl chloride, there might be some possibility that unconfined vapor clouds of methyl chloride may explode if ignited.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent skin contact with cold methyl chloride or cold containers and any reasonable probability of eye contact with the cold product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene and nitrite-butadiene rubber.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1063

METHYL CHLORIDE
Class 2.1 (Flammable Gas)

FIRST AID

Nonspecific symptoms: Frostbite; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. Do not administer adrenalin.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or skin irritation persists after washing. Do not use hot water or rub frostbitten areas.

First Aid for Ingestion: If victim is conscious, give warm water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas. Use dry chemical, carbon dioxide, or water fog as necessary but note that water may increase gas evolution from any pools of liquid methyl chloride.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the highly volatile, flammable, and toxic nature of methyl chloride into account while planning the response. Note also that heavy gas may persist in pits and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl chloride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYL CHLORIDE
Class 2.1 (Flammable Gas)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl chloride vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid methyl chloride as this may increase gas or vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of methyl chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methyl chloride or its solutions may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained methyl chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

METHYL CHLORIDE
Class 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards, particularly if any hydrochloric acid has formed in the water.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

METHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Methyl chloroformate is a colorless to light yellow poisonous liquid with an irritating, pungent, unpleasant, and acrid odor. It is used for making pharmaceuticals, herbicides, plastics, and other chemicals, and was once used by the military as a warfare agent. The substance is slightly heavier than water, slightly soluble, and slowly reactive, so may be expected to sink slowly while simultaneously reacting to form methyl alcohol and hydrochloric acid. Its flash point indicates it may be easily ignited under a wide range of ambient temperature conditions. Vapors may travel some distance to a source of ignition and flash back, particularly at warmer temperatures. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 10.3 pounds per gallon.

Methyl chloroformate is relatively stable in normal transportation, except for an apparent tendency to decompose slowly to hydrogen chloride and methyl alcohol, but is reactive with a variety of other chemicals, certain types of metals and rubber, and certain metallic rusts and salts. Any hydrochloric acid formed will be corrosive to most metals and may cause evolution of flammable and potentially explosive hydrogen gas during the corrosion process. The corrosivity of methyl chloroformate itself to bodily tissues is high and requires that all contact with the product be strictly avoided. Products of combustion are both toxic and corrosive and may include hydrochloric acid, phosgene, chlorides or chlorine, chloroformate fumes, carbon monoxide, and other toxic constituents.

If methyl chloroformate is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half ($^{1}/_{2}$) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; gradually decomposes (see below).

Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, and ether.

Specific gravity (Liquid): 1.22 at 68°F (20°C)

Boiling Point: 158–161.6°F (70–72°C) at 1 atm.

Melting Point: –113.8°F (–81°C) or below; reported values vary.

Freezing Point: See melting point

Molecular Weight: 94.5

Heat of Combustion: –2600 cal/g

Vapor Pressure: 529.3 mm Hg (10.23 psia) at 141°F (60.6°C)

Flash Point: Reported values range widely from below 30°F (–1.1°C) to 76°F (24.4°C) on both closed cup and open cup basis.

Autoignition Temperature: 904°F (484°C) or 940°F (504°C); reported values vary.

Burning Rate: 2.0 mm/minute

Stability: Stable in normal transportation except for possible slow decomposition.

Corrosiveness: Any hydrochloric acid formed will be corrosive to most metals, particularly iron and aluminum, with evolution of hydrogen gas. Best handled in glass, lead, porcelain, tantalum, high density polyethylene, polypropylene, or furans. Attacks elastomeric materials such as rubber (e.g., neoprene, Viton, etc.).

Reactivity with Water: Reacts slowly to form flammable methyl alcohol and corrosive hydrochloric acid (also known as muriatic acid) or hydrogen chloride while generating heat. Reaction may be hazardous if water is hot.

Reactivity with Other Chemicals: Incompatible with oxidizing agents, alkali or caustics, amines, certain types of rubber and certain metals (and possibly their rust). Iron, zinc, and aluminum salts may catalyze decomposition, possibly explosively.

IDENTIFICATION

Shipping Names: Methyl chloroformate (USDOT and IMO); methyl chlorocarbonate (IMO).

Synonyms and Tradenames: Methyl chlorocarbonate; chloroformic acid, methyl ester; methoxycarbonyl chloride; carbonochloridic acid, methyl ester; K-stoff.

Chemical Formula: $ClCOOCH_3$

Constituent Components (% each): 95% or more pure; remainder may include small amounts of hydrochloric acid, dimethyl carbonate, and possibly a trace of phosgene.

UN/NA Designation: UN1238

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless to light yellow

Odor Characteristics: Acrid; unpleasant; pungent; irritating

Common Uses: Making of pharmaceuticals, herbicides, plastics, and other organic chemicals; used as military warfare agent in World War I.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

METHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly flammable and corrosive liquid. Reacts with water to form methyl alcohol and hydrogen chloride or hydrochloric acid.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the relatively high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct physical contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Methyl chloroformate is considered to be corrosive and destructive to living tissue. Contact with the skin or eyes may cause severe acid-type burns and the skin may become sensitized on occasion. Vapors of the product are irritating to the eyes and cause tears, with 10 ppm being sufficient to cause an effect in 10 minutes. Irritation may persist after cessation of exposure.

Hazards of inhalation: Vapors of methyl chloroformate are highly irritating to the respiratory tract. Data for this and related products indicate that inhalation may cause burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting, choking, chest pain, edema of the larynx and bronchi, chemical pneumonitis, pulmonary edema (which may be delayed in onset), and possibly death. Exposure to 190 ppm for 10 minute scan be lethal to humans.

Hazards of Ingestion: May cause severe burns of the mouth, throat, and stomach leading to death. Similar materials cause stomach pain, nausea, vomiting, and esophageal or gastric necrosis.

FIRE HAZARDS

Lower Flammable Limit (LFL): 6.7%

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire due to overheating and/or product decomposition. May generate large quantities of flammable and corrosive gas or vapor upon release.

Hazardous Combustion Products: Toxic and corrosive; may include hydrochloric acid, phosgene, chlorides or chlorine, chloroformate fumes, carbon monoxide, and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Note that some chloroformates may explode due to pressure or catalysis.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with methyl chloroformate. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full face piece (or the equivalent).

1238

METHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; choking, coughing, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, halon, foam. Note that methyl chloroformate may react with water. Water or foam should be applied with caution at first.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated . Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the corrosive, flammable, reactive, and volatile nature of the product into account when planning the response. Note that sealed containers may contain some pressure due to product decomposition.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl chloroformate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities of fumes and vapors are being generated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to methyl chloroformate vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain methyl chloroformate, hydrochloric acid, and methyl alcohol from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM ... There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of hazardous vapors or fumes into the atmosphere. (Note: Since foam is recommended for firefighting, it may also be beneficial for this purpose. Due to the potential reactivity of the product, apply foam with caution at first. Be advised that various authorities disagree on whether alcohol or regular foam should be used.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION ... The rapid addition of flooding quantities of water to contained liquid methyl chloroformate may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid methyl chloroformate and its products of reaction with water may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

METHYL CHLOROFORMATE
Division 6.1 (Poisonous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION ... Spreading of liquids may be controlled by absorbing liquid with dry sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

METHYL CHLOROFORMATE

Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION ... Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: This response will address presence of acid but not alcohol. See next technique for alcohol removal where necessary. Note also that some time may be necessary for reaction of product with water.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

METHYLCHLOROMETHYL ETHER

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Methylchloromethyl ether is a colorless poisonous liquid that has an irritating odor and that is used for treating textiles and making ion exchange resins, pharmaceuticals, and other chemicals. Its flash point of 0°F indicates the product is easily ignited under most ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approxiately 8.9 pounds per gallon.

Methylchloromethyl ether is stable in normal transportation but reacts with water or moisture to rapidly (but nonviolently) form formaldehyde, hydrogen chloride or hydrochloric acid, and methanol. Any hydrochloric acid formed will be corrosive to most metals and may evolve flammable and potentially explosive hydrogen gas during the corrosion process. Although specific information on other reactivity hazards is unavailable, the product may also be assumed to be incompatible with strong oxidizing agents that may cause its ignition. Toxicity of the product must be considered high due to its corrosive effects on bodily tissues and the fact that it is a suspected human carcinogen in long term occupational exposures. Products of combustion are highly toxic and irritating and may include hydrogen chloride, phosgene, and carbon monoxide. Any unburned material may form a powerful tear gas in air.

Downwind evacuation should be considered if methylchloromethyl ether is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below

Solubility in Other Chemicals: Soluble in alcohol, ether, and acetone. Decomposes in hot alcohol.

Specific Gravity (Liquid): 1.061 – 1.074 at 68°F (20°C)

Boiling Point: 138.2 –139.1°F (59 – 59.5°C) at 1 atm.

Melting Point: –154.3°F (–103.5°C)

Freezing Point: See melting point

Molecular Weight: 80.5

Heat of Combustion: – 4,100 cal/g (est.)

Vapor Pressure: Estimated 191.7 mm Hg (3.705 psia) at 70°F (21.1°C)

Flash Point: 0°F (–17.8°C), open cup

Autoignition Temperature: Unavailable

Burning Rate: 3.0 mm minute

Stability: Stable in normal transportation.

Corrosiveness: Any hydrochloric acid formed in contact with moisture will be corrosive to most metals, particularly iron and aluminum, with evolution of hydrogen gas.

Reactivity with Water: Reacts rapidly but not violently with water to form formaldehyde, hydrogen chloride or hydrochloric acid, and methanol.

Reactivity with Other Chemicals: Unavailable. Would at least expect incompatibility with strong oxidizing agents.

IDENTIFICATION

Shipping Names: Methyl chloromethyl ether, anhydrous (USDOT & IMO); methylchloro-methyl ether (IMO)

Synonyms and Tradenames: Chloromethoxymethane; chloromethylmethyl ether; chlorodimethyl ether; monochlorodimethyl ether; CMME dimethylchloroether; methoxymethylchloride; methoxychloromethane

Chemical Formula: CH_3OCH_2Cl

Constituent Components (% each): Commercial grade may contain 1– 8% of highly carcinogenic bis(chloromethyl) ether.

UN/NA Designation: UN1239

IMO Designation: 6.1, poisonous Substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Irritating

Common Uses: Synthesis of chloromethylated chemical compounds, ion exchange resins, and some pharmaceuticals; treatment of textiles.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYLCHLOROMETHYL ETHER

Division 6.1 (Poisonous Material)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Volatile, flammable, toxic, reactive, and potentially corrosive liquid. Vapors are heavier than air and may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA):Listed as suspected human carcinogen by ACGIH. Minimize exposure.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in the spill area and downwind. Ingestion and direct physical contact are also to be strictly avoided. Note that this product is a suspected human carcinogen (causing lung cancer) in long term occupational exposures and also has mutagenic properties.

Hazards of Skin or Eye Contact: Contact of the skin with liquid methylchloromethyl ether may result in pain and second degree burns after only a few minutes. Contact of the eyes may result in severe burns and corneal necrosis.

Hazards of Inhalation: Vapors of methylchloromethyl ether are irritating to the eyes, nose, and throat. Severe exposures may result in coughing, wheezing, fever, chills, difficult breathing, pulmonary congestion, pulmonary edema (which may be delayed in onset), blood stained sputum, pneumonia, and possibly death. A concentration of 313 ppm in air was fatal to 50% of mice in two hours in laboratory experiments. Exposures to 55 and 65 ppm were respectively and similarly lethal to rats and hamsters in seven hours.

Hazards of Ingestion: Ingestion of methylchloromethyl ether may cause severe burns of the mouth, throat, and stomach leading to possible death.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable and corrosive vapors or fumes upon release.

Hazardous Combustion Products: Highly toxic and irritating; may include hydrogen chloride, phosgene, and carbon monoxide. Unburned material may form powerful tear gas.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with methylchloromethyl ether. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

1239

METHYLCHLOROMETHYL ETHER
Division 6.1 (Poisonous Material)

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, carbon dioxide, foam. Note that water reacts with the product nonviolently to form water soluble flammable liquids. Water may possibly be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the volatile, flammable, toxic, reactive, and potentially corrosive nature of the product into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methylchloromethyl ether spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methylchloromethyl ether vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain various chemicals from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

METHYLCHLOROMETHYL ETHER

Division 6.1 (Poisonous Material)

TECHNIQUE

DILUTION . . . The addition of flooding quantities of water to liquid methylchloromethyl ether may eventually slow the release of vapors or fumes into the atmosphere. This response may be better suited to smaller spills and entails special risks if the reaction with water becomes hazardous.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

FOAM . . . There is a possibility that application of an appropriate firefighting foam to the surface of liquid pools may slow the release of vapors into the atmosphere. The fact that foam is recommended for firefighting suggests it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methylchloromethyl ether may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

METHYLCHLOROMETHYL ETHER

Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. (Note: Neutralization agents can only be used to modify any hydrochloric acid or formaldehyde formed in reactions with water. Methanol may still be present.)

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

METHYLCHLOROMETHYL ETHER

Division 6.1 (Poisonous Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Neutralization agents can only be applied to hydrochloric acid and formaldehyde formed in water. Methanol will still be present in water.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture some of the formaldehyde in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

METHYLDICHLOROSILANE
Division 4.3 (Dangerous When Wet)

GENERAL INFORMATION

Methyldichlorosilane is a clear, colorless to straw colored, highly flammable, corrosive, and fuming liquid with an odor variably described as sharp, pungent, acrid, irritating and resembling hydrochloric acid. It can be easily ignited under virtually all ambient temperature conditions. A reported boiling point range of 105.8 - 107.6°F (41 - 42°C) indicates that methyldichlorosilane is highly volatile, will boil at high ambient temperatures, and will rapidly vaporize and evolve relatively large quantities of vapors and fumes. Its vapors and fumes are heavier than air, may persist for a time in low areas, and may travel a considerable distance to a source of ignition and flash back. Accumulations in confined spaces such as buildings or sewers may explode if ignited. The liquid weighs 9.2 - 9.3 pounds per gallon.

Although stable when in sealed containers, methyldichlorosilane reacts violently with water to form corrosive hydrochloric acid and flammable hydrogen gas while generating heat, white acid fumes, and a mixture of methylsiloxanes. The liquid product also generates acid fumes when exposed to moist or humid air. Methyldichlorosilane is otherwise reactive with a broad range of materials and may form explosive mixtures with several. Both the liquid and its vapors and fumes are highly corrosive to bodily tissues by all routes of exposure. Products of combustion are not well defined but are variably reported to include corrosive hydrogen chloride and hydrochloric acid, extremely toxic phosgene gas, carbon monoxide, carbon dioxide, silicon oxide, silicon dioxide, highly dispersed silica, and other irritant and toxic substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if methyldichlorosilane is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts violently.

Solubility in Other Chemicals: Soluble in benzene, ether, heptane, and toluene.

Specific Gravity (Liquid): 1.11 at 77°F (25°C).

Boiling Point: 105.8 - 107.6°F (41 - 42°C) at 1 atm.

Melting Point: - 135°F (- 93°C) or - 131°F (- 90.6°C).

Freezing Point: See melting point.

Molecular Weight: 115.04.

Heat of Combustion: - 2,600 cal/g.

Vapor Pressure: 100 mm Hg (1.933 psia) at 15.8°F (- 9°C); 400 mm Hg (7.732 psia) at 74.7°F (23.7°C).

Flash Point: - 26 to - 15°F (- 32.2 to - 26.1°C), closed-cup; - 14°F (- 25.6°C), open-cup.

Autoignition Temperature: 600°F (316°C) or greater.

Burning Rate: Not available.

Stability: Stable in sealed container.

Corrosiveness: Carbon steel is satisfactory for use with the dry product but any contact with water or moisture produces hydrochloric acid which is corrosive to most metals, particularly iron and aluminum, and which will generate flammable and potentially explosive hydrogen gas.

Reactivity with Water: Reacts violently with water to form hydrochloric acid and hydrogen gas while generating heat, white acid fumes, and a mixture of methylsiloxanes. Methyldichlorosilane will generate acid fumes and hydrogen gas when exposed to moist or humid air.

Reactivity with Other Chemicals: Generates flammable gases and possibly hydrogen chloride gas upon contact with acids, bases (alkalis), or oxidizing materials. The hydrogen gas evolved upon contact with a base may ignite spontaneously. Mixtures with potassium permanganate, lead (II) oxide, lead (IV) oxide, copper oxide, or silver oxide form impact-sensitive explosive materials. The very similar methyltrichlorosilane is reported as incompatible and capable of potentially violent reactions with chemically active metals such as potassium, sodium, magnesium, and zinc. Overall, methyldichlorosilane should be considered to be a highly reactive substance capable of reacting vigorously, violently or explosively with a broad range of other materials.

IDENTIFICATION

Shipping Names: Methyldichlorosilane.

Synonyms and Tradenames: Dichlorohydridomethylsilicon; dichloromethylsilane; methyl dichlorosilane; and monomethyldichlorosilane.

Chemical Formula: CH_3SiHCl_2.

Constituent Components (% each): Typically 95% to 99% pure with remainder consisting of similar silanes.

UN/NA Designation: UN1242.

IMO Designation: 4.3, Dangerous When Wet.

Physical State As Shipped: Liquid.

Physical State As Released: Fuming and/or boiling liquid, gas, or mixture of gas and aerosols.

Color of the Shipped Material: Colorless; to straw colored.

Odor Characteristics: Variably described as sharp, pungent, acrid, irritating, and resembling hydrochloric acid.

Common Uses: Used to make silicon polymers.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

METHYLDICHLOROSILANE
Division 4.3 (Dangerous When Wet)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10 ppm in air. Range for hydrogen chloride or hydrochloric acid is 1 to 5 ppm.
Unusual Hazards: Highly reactive fuming liquid. Reacts violently with water. Spraying water on the source of any leak may potentially cause corrosion due to formation of hydrochloric acid and increase the leakage area.
Short Term Exposure Limit (STEL): Not established by recognized authority.
Time Weighted Average (TWA) Limit: Not established by recognized authority.
Ceiling (C) Limit: Not established for methyldichlorosilane. For hydrogen chloride, the absolute ceiling limit is 5 ppm (ACGIH, 1992 -93; OSHA, 1989).
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; contact with water or moisture; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Methyldichlorosilane is highly corrosive to bodily tissues by all routes of exposure. Dangerous concentrations of vapors and fumes may be present in air in the spill area and over considerable downwind distances.
Hazards of Skin or Eye Contact: Liquid methyldichlorosilane may rapidly cause severe burns and tissue destruction upon contact with the skin or eyes, with eye effects possibly including inflammation, damage to the cornea and eyelids, and possibly permanent injury and/or loss of sight. Effects due to skin contact may additionally include inflammation, pain, shock, and a risk of secondary infections. Exposure to concentrated vapors or fumes in air may also cause significant eye and skin irritation and also has the potential to result in eye damage. Contact lenses should not be worn when working with this chemical.
Hazards of Inhalation: Vapors and fumes of methyldichlorosilane are highly irritating and corrosive to the nose, mouth, throat, respiratory tract, and lungs. Excessive exposures may result in such symptoms as a burning sensation, immediate distress, coughing, wheezing, hoarseness, laryngitis, shortness of breath, a choking sensation, headache, nausea, vomiting, spasms, bleeding of the nose and gums, possible ulceration of nasal and oral mucosa, inflammation and edema of the larynx and bronchi, possible kidney damage, loss of consciousness, pulmonary edema (which may be delayed in onset), chemical pneumonitis, and possibly death. Exposure to 300 ppm of methyldichlorosilane in air for 4 hours was sufficient to kill 50% of rats in laboratory experiments. It has been crudely estimated that exposure to 3000 ppm of methyldichlorosilane or 6000 ppm of anhydrous hydrochloric acid (i.e., hydrogen chloride) for 10 minutes (and possibly less) may be lethal to some humans. More conservative estimates are that concentrations of 1300 to 2000 ppm of hydrogen chloride in air may be lethal within a few moments. The saturated vapor concentration over a pool of liquid methyldichlorosilane is about 131,580 ppm at 15.8°F (-9°C) and 464,475 ppm at 68°F (20°C). At or above its boiling point of 105.8 -107.6°F (41- 42°C), vapor concentrations will be 100% by volume.
Hazards of Ingestion: Ingestion of methyldichlorosilane will cause severe burns of the mouth, throat, and stomach and may prove fatal. Symptoms presumed to be associated with excessive single oral doses (based on the effects of similar materials) include increased salivation, intense thirst, difficulty in swallowing, chills, pain, and shock. Vomit may have the appearance of coffee grounds. The potential for circulatory collapse is expected to be high.

FIRE HAZARDS

Lower Flammable Limit: 3.4% to 6%.
Upper Flammable Limit: Greater than 55%.
Behavior in Fire: Flammable liquid. Difficult to extinguish and prone to reignition. May generate large quantities of flammable and corrosive vapors and fumes upon release. Vapors may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in a fire and possibly rocket.
Hazardous Combustion Products: Not well-defined; variably reported to include corrosive hydrogen chloride and hydrochloric acid, extremely toxic phosgene, carbon monoxide, carbon dioxide, silicon oxide, silicon dioxide, highly dispersed silica, and other irritants and toxic substances.

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in a fire and possibly rocket. Reaction with water or moisture produces potentially explosive hydrogen gas as well as hydrochloric acid. This acid may evolve hydrogen gas in contact with most metals. Mixtures with certain other chemicals may result in an explosion or formation of explosive compounds. There is a possibility that entry of water into a closed container of methyldichlorosilane may result in its rupture if sufficiently high gas and vapor pressures are generated.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and/or gas-tight safety goggles, and other

1242

METHYLDICHLOROSILANE
Division 4.3 (Dangerous When Wet)

PROTECTIVE CLOTHING AND EQUIPMENT *(CONTINUED)*

impervious and resistant clothing as appropriate. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary for fire fighting and wherever high vapor or fume concentrations may be encountered in air. Based on limited data, one authority indicates that Viton and polyethylene/ethylene vinyl alcohol/polyethylene (PE/EVAL/PE) materials may be compatible with methyldichlorosilane. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting, spasms, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If conscious, have victim wash out mouth with large amounts of water which should not be swallowed; then slowly administer 1 or 2 glasses of water or milk to an adult, proportionately less to a chill. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Authorities disagree substantially on which agents to apply. NFPA 49 recommends dry chemical, carbon dioxide, foam, or water spray while noting that water may be ineffective. The U.S. DOT (in ERG90) agrees with the NFPA for small fires but suggests use of water spray, fog, or regular foam on large fires. A major maker of the product warns that water should not be used because of the violent reaction that may take place but considers the use of foam acceptable. A Coast Guard publication warns not to use either water or foam because of the reaction problem. A major Canadian response guide suggests use of dry chemical, soda ash, or lime on small fires. For large fires, it says to use dry sand, dry chemical, soda ash or lime, or else to withdraw from area and allow fire to burn. Everyone agrees that no water should be permitted to enter containers. Overall, it appears most prudent to avoid use of water or foam if the fire is small unless the burning liquid can rapidly and truly be flooded with comparatively massive amounts. For large fires which cannot reasonably be permitted to burn themselves out, use extreme caution and apply water in very large quantities as a spray or fog, or apply large amounts of foam, from a protected location or from as far a distance as possible. Use professional judgment as necessary to select from or modify these recommendations.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with products of combustion or vapors/fumes of methyldichlorosilane is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire. Do not apply water or foam to leakage area of methyldichlorosilane containers or permit either to enter such containers if possible.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product or its vapors or fumes. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use. Handle and store this material under dry nitrogen if possible. Take all the reactivity, corrosivity, toxicity, volatility, and flammability hazards of methyldichlorosilane into account when planning the response.

METHYLDICHLOROSILANE
Division 4.3 (Dangerous When Wet)

AIR SPILL *(CONTINUED)*

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and allow vapors or fumes to dissipate. Methyldichlorosilane spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors and fumes in air may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid methyldichlorosilane as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain varying amounts of hydrochloric acid and other chemicals from contact with vapors and fumes.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FLOODING WITH WATER . . . The rapid addition of flooding quantities of water to pools of liquid methyldichlorosilane may eventually slow the release of vapors and fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor and fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. The reaction between water and methyldichlorosilane may be violent.

MITIGATION

Some possibilities include knockdown of vapors and fumes via large amounts of water fog and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts. Contain resulting liquids and neutralize and/or remove them as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that alcohol or regular foam applied to the surface of liquid pools may slow the release of vapors and fumes into the atmosphere. (Note: Several authorities suggest foam use for firefighting even though the water in the foam will clearly react with the spilled product. Thus, foam may possibly control vapor and fume evolution if a blanket can be maintained over liquid pools.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. There may be at least an initial increase in vapor and fume evolution when the foam is first applied.

MITIGATION

Proceed with caution. Stand ready to control increases in vapor or fume evolution with water spray or fog applied at a point downwind and/or temporarily evacuate downwind populations and other vulnerable resources. Abandon the effort if vapor and fume evolution does not decrease after a reasonable amount of foam has been applied. If the method works, continue foam application until the spilled product is removed or otherwise treated. Contain increased volume of liquids.

TECHNIQUE

NEUTRALIZATION . . . There is a possibility that application of an appropriate neutralization agent to liquid methyldichlorosilane may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing methods.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methyldichlorosilane, its reaction products with water, or contaminated water runoff may be contained by building dikes or barriers using dry sand, soil, or other compatible materials.

LAND SPILL *(CONTINUED)*

Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained substances and spread of contamination.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION.. . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the liquid may become damaged or develop leaks. High pressures may rapidly develop in equipment if methyldichlorosilane is recovered under high ambient temperature conditions or if water or moisture is present in the equipment.

MITIGATION

Use compatible equipment that has adequate pressure capacity and is free of moisture as and if necessary. Consider using a cold gas such as carbon dioxide or nitrogen to precool transfer lines and receiving containers. Consult qualified experts as necessary for advice on safe precooling techniques.

TECHNIQUE

ABSORPTION . . . Spreading of liquids may be controlled by absorbing them with dry sand, earth, clay, lime, soda ash, vermiculite, commercial sorbents, or other compatible substances as appropriate and available according to various authorities.

CONSEQUENCE

Once used, most sorbent materials pose the same hazards as the absorbed liquid. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product or other contained liquids to less hazardous substances.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and/or chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product and any hydrochloric acid that may be present. Do not operate motorized equipment in potentially flammable atmospheres (including those caused by evolution of hydrogen gas due to reaction of water with methyldichlorosilane or corrosion of metals by hydrochloric acid). Consult qualified experts for advice where necessary.

METHYLDICHLOROSILANE
Division 4.3 (Dangerous When Wet)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Methyldichlorosilane reacts violently with water to produce corrosive hydrochloric acid, potentially large quantities of acid fumes, and a mixture of methylsiloxanes that are not generally soluble in water. Specific data on the nature, properties, and hazards of these methylsiloxanes were not available, so only general guidance can be provided about containment and recovery methods that may be appropriate. Contact shippers or other sources of expert advice for assistance.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION. . . Application of a suitable neutralization agent to the contaminated water may reduce the environmental hazards of hydrochloric acid.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

CONTAINMENT . . . Some methylsiloxanes are likely to sink in water and not dissolve therein. Where necessary, use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Where deemed necessary and appropriate, stream or lake beds may be dredged to remove heavier-than-water methylsiloxanes and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. There may be other hazards associated with methylsiloxanes.

MITIGATION

Consult qualified experts for guidance.

METHYLENE DIPHENYL DIISOCYANATE*

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Methylene Diphenyl Diisocyanate is a dark brown poisonous liquid with a weak musty odor used to bond rubber to rayon and nylon, and in two component polyurethane coating systems which are used for aircraft, tank trucks and truck trailers due to durability and toughness. It is also used to produce polyurethane lacquer coatings applied to certain automobile components. Methylene diphenyl diisocyanate is manufactured from the reaction of P,P-diphenylmethane diamine and phosgene.

Methylene diphenyl diisocyanate liquid, vapors and aerosols are irritants to the mucous membranes in the respiratory tract (nose, throat and lungs). It is also an irritant to the skin and eyes. The most common routes of exposure are through inhalation and skin contact. It may be absorbed through the skin in toxic amounts. Ingestion of the product can cause irritation and corrosive action in the mouth, stomach tissue and digestive tract. It is a skin and pulmonary sensitizer.

The fire potential for Methylene diphenyl diisocyanate is moderate, however, when heated it will release highly toxic and irritating gases. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for working in atmospheres where methylene diphenyl diisocyanate is present. Runoff may be toxic. Methylene diphenyl diisocyanate is not water soluble. The product is normally stable, however at temperatures greater than 400°F, or if the product comes into contact with incompatible materials, it can polymerize and decompose which can cause pressure build-up in closed containers. It is compatible with amines, strong bases and alcohols.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble.
Solubility in Other Chemicals: Acetone, benzene, kerosene and nitrobenzene.
Specific Gravity (Liquid): 1.2 @ 25°C (77°F)
Vapor Density (Air=1): 8.5
Boiling Point: 208°C (406°F)
Melting Point: 37°C (99°F)
Freezing Point: Unavailable.
Molecular Weight: 250.27
Heat of Combustion: Unavailable.
Vapor Pressure: 0.001 mm Hg at 40°C (104°F)
Flash Point: 202°C (396°F)
Autoignition Temperature: Not established.
Flammable Limits: Not established.
Stability: Stable.
Polymerization Potential: May occur.
Reactivity and Incompatibility: Incompatible with amines, strong bases and alcohols.
Other Characteristics: Will cause some corrosion to copper alloys and aluminum. Product reacts slowly with water to form carbon dioxide. This can cause sealed containers to expand and possibly rupture.

IDENTIFICATION

Shipping Name(s): Methylene Diphenyl Diisocyanate
Synonyms and Tradenames: MDI, Methylenebis (4-Phenylisocyanate), Mondur 577, 4,4-Methylene Diphenyl Diisocyanate, Diphenylmethane Diisocyanate, Methylene Bisphenyl Isocyanate, Methylene Di-P-Phenylene. CAS Registry No: 101-68-8.
Chemical Formula: $CH_2(C_6H_4NCO)_2$
Molecular Formula: $C_{15}H_{10}N_2O_2$
UN/NA Designation: UN2489
IMO Designation: 6.1
RTECS Number: NIOSH/NQ9350000
OHMTADS Number: Unavailable.
NFPA 704 Hazard Rating: 3 (Health): 1 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Dark brown
Odor Characteristics: Weak, musty odor
Common Uses: Used to bond rubber to rayon and nylon, and in two component polyurethane coating systems which are used for aircraft, tank trucks and truck trailers due to durability and toughness. It is also used to produce polyurethane lacquer coatings applied to certain automobile components.

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*Reportable Quantity (RQ) established. Refer to appendix I.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHYLENE DIPHENYL DIISOCYANATE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Products of combustion may include traces of hydrogen cyanide. Contamination with water results in a slow reaction that liberates CO_2 gas. Warning properties (i.e., irritation of the eyes, nose, throat or odor) are not adequate to prevent exposure.

Time Weighted Average (TLV-TWA): 0.005 ppm

Short Term Exposure Limit (STEL):Unavailable.

IDLH: Approximately 10 ppm.

Conditions to Avoid: Heat, sparks, flame, incompatible materials, such as strong bases, amines, and alcohols, contamination with water, runoff to sewers, storm drains and waterways, skin contact, inhalation and ingestion. Material may not be stored near food stuffs.

HEALTH HAZARDS

Potential Health Effects: Methylene diphenyl diisocyanate is a skin, eye, nose, throat and lung irritant. May be fatal if absorbed through the skin or inhaled in toxic amounts. Prolonged contact can cause skin and pulmonary sensitization. Individuals with pre existing, non-specific bronchial hyperactivity can respond to concentrations below the TLV with similar symptoms, as well as asthma attack. Exposures well above the TLV may lead to bronchitis, bronchial spasm, and pulmonary edema. These effects are usually reversible. Chemical pneumonitis has also been reported. These symptoms may be delayed up to several hours after exposure. Medical conditions aggravated by exposure include asthma, bronchitis, emphysema, and skin allergies. This product can produce asthmatic sensitization upon either a single inhalation exposure to a relatively high concentration or upon repeated inhalation exposures to lower concentrations.

Hazards of Skin and Eye Contact: Product reacts with skin protein and moisture, and can cause irritation that includes redness, swelling, rash, scaling or blistering. Prolonged contact can cause skin sensitization. Individuals who suffer skin sensitization can develop these symptoms from contact with liquid or vapors. Liquid, aerosols and vapors are irritating to the eyes and can cause tearing, redness and swelling. If left untreated, corneal damage can occur and injury is slow to heal. However, damage is usually reversible.

Inhalation Hazards: Vapors or mists at concentrations above the TLV can irritate (i.e., burning sensation) the mucous membranes in the respiratory tract (nose, throat, lungs) causing runny nose, sore throat, coughing, chest discomfort, shortness of breath, and reduced lung function. Individuals with preexisting, non-specific bronchial hyperactivity can respond to concentrations below the TLV with similar symptoms, as well as asthma attack. These effects are usually reversible. Chemical pneumonitis has also been reported. These symptoms may be delayed up to several hours after exposure.

NOTE: As a result of previous repeated overexposures or a single large dose, certain individuals develop isocyanate sensitization (chemical asthma) which will cause them to react to a later exposure to isocyanate levels well below the TLV. These symptoms which include chest tightness, wheezing, cough, shortness of breath or asthma attack, could be immediate or delayed (up to several hours after exposure). This sensitization may be temporary or permanent.

Ingestion Hazards: Ingestion may result in irritation and corrosive action in the mouth, stomach tissue, and digestive tract. Symptoms include sore throat, abdominal pain, nausea, vomiting and diarrhea.

FIRE HAZARDS

Lower Flammable Limit: Not established.

Upper Flammable Limit: Not established.

Behavior in Fire: Although it will not readily ignite, methylene diphenyl diisocyanate will burn if exposed to sources of heat and flame.

Hazardous Decomposition Products: When heated to decomposition, product generates highly toxic and irritating gases such as carbon monoxide, oxides of nitrogen, and traces of hydrogen cyanide.

EXPLOSION HAZARDS

Explosive Potential: Although the product is generally stable and the potential for an explosion is low, at temperatures greater than 400°F, or if the product comes into contact with incompatible materials, it can polymerize and decompose which can cause pressure build-up in closed containers. Containers may violently rupture. Violent reactions may also occur if the product comes into contact with alcohols.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

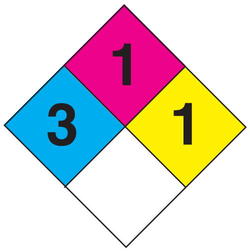
Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Fully encapsulating, vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are nitrile rubber and butyl rubber. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits.

2489

METHYLENE DIPHENYL DIISOCYANATE

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Skin contact can produce irritation, inflammation, and dermatitis. Central nervous system (CNS) effects may include nausea, headache, dizziness or general weakness. The material is known to be a mucous membrane irritant. Other symptoms may include vomiting, diarrhea, coughing, difficulty breathing, sore throat and abdominal pain.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if in place. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water or milk. DO NOT INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physicians: Eye Exposures. Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. For skin exposures, treat symptomatically as for contact dermatitis or thermal burns. For ingestion, treat symptomatically. There is no specific antidote.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray, AFFF multi-purpose foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water spray to cool fire-exposed containers, disperse vapors, and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may rupture violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be toxic.

SPILL RESPONSES

General Information: Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, storm drains or waterways. If temporary control of vapors is required, a blanket of protein foam may be placed over the spill. Overflow dams may be effective to dike material since it is not water soluble and it is heavier than water. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers. Runof may be toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous concentrations before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

METHYLENE DIPHENYL DIISOCYANATE

Division 6.1 (Poisonous Materials)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, storm drains or waterways.

TECHNIQUE

MONITOR THE SITUATION...If released into the atmosphere, methylene diphenyl diisocyanate is expected to exist primarily in the vapor phase. Depending on the magnitude of the release, toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Reaction with water vapor in the atmosphere may significantly increase the degradation rate. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, storm drains or waterways.

TECHNIQUE

FOAM...Aqueous Film Forming Foam (AFFF) or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation. If temporary control of vapors is required, a blanket of protein foam may be placed over the spill.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

METHYLENE DIPHENYL DIISOCYANATE
Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, product will react with water to form a hard crust of inert, water insoluble material. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Product will react with water to form a hard crust of inert, water insoluble material comprised primarily of polyureas. This crust will prevent further contact with water, thereby increasing the persistence time. Dams may be used to confine or divert the spill to a limited area until the material can be recovered.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may be an effective means to recover spilled material since the material is not water soluble and crust will float on the surface of the water. Barriers of suitable material may be used to con fine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming may be effective since the material is not water soluble and crusts will float on the surface of the water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dis pose of contaminated water as soon as possible in accordance with applicable local, state and federal envi ronmental regulations. Consult environmental specialists for assistance, as needed.

METHYLENE DIPHENYL DIISOCYANATE

Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...Liquid will solidify on contact with soil, therefore leaching will not occur. Product will react with water to form a hard crust of inert, water insoluble material comprised of polyureas. This crust will prevent further contact with water, thereby increasing the persistence time. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

May result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains or sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

January 1988

METHYL ETHYL KETONE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl ethyl ketone is a colorless fairly volatile liquid with a pleasant pungent odor like acetone or lacquer thinner. It is used as a solvent, for making other chemicals, and for production of wax from petroleum. It is moderately soluble in water and lighter, so may be expected to float while rapidly dissolving. Its flash point of 20°F indicates that the product is easily ignited under a wide range of ambient temperature conditions. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.7 pounds per gallon.

Methyl ethyl ketone does not react with water or many common materials and is stable in normal transportation. It is reactive with strong oxidizing materials, however, and will dissolve or soften some plastics. Toxicity is low to moderate via the various potential routes of exposure, but vapors are highly irritating and may be present in air in relatively high concentrations. Products of combustion may include toxic constituents.

Downwind evacuation should be considered on a case by case basis if methyl ethyl keytone is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 27 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.
Specific Gravity (Liquid): 0.806 at 68°F (20°C)
Boiling Point: 175.3°F (79.6°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –123.3°F (–86.3°C)
Molecular Weight: 72.11
Heat of Combustion: –7491 cal/g
Vapor Pressure: 71.2 mm Hg (1.38 psia) at 68°F (20°C)
Flash Point: 20°F (–6.7°C), closed cup; 22°F (–5.6°C), open cup.
Autoignition Temperature: 961°F (516°C)
Burning Rate: 4.1 mm/minute
Stability: Stable
Corrosiveness: Softens or dissolves some plastics
Reactivity with Water: No reaction
Reactivity with Other Chemicals: May react with strong oxidizers, chlorosulfonic acid, oleum, potassium tert-butoxide, peroxides, explosives, radioactive materials, and poisons.

IDENTIFICATION

Shipping Names: Methyl ethyl ketone (USDOT or IMO); ethyl methyl ketone (USDOT or IMO).
Synonyms and Tradenames: 2-Butanone, MEK, butanone, ethyl methyl ketone, methyl acetone, butanone.
Chemical Formula: $CH_3COCH_2CH_3$
Constituent Components (% each): 99% or more pure
49 STCC: 49 092 43
UN/NA Designation: UN1193
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pleasant, pungent, like acetone, lacquer thinner, or mint.
Common Uses: Solvent for resins, nitrocellulose coatings, vinyl films, cements and adhesives, dewaxing lube oils, nail polish remover, cleaning fluids, and paint stripper manufacturing of smokeless powder and other chemicals; printing catalyst and carrier.

METHYL ETHYL KETONE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10.9–27 ppm
Unusual Hazards: Fairly volatile flammable liquid with heavier than air vapors that may travel to a source of ignition.
Short Term Exposure Limits (STEL): 300 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 200 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the local spill area and immediately downwind. Ingestion and physical contact are also to be avoided.
Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid methyl ethyl ketone may result in drying and irritation of the skin. Contact with the eyes may cause irritation and moderate but usually reversible injury.
Hazards of Inhalation: Vapors of methyl ethyl ketone cause irritation of the eyes, nose, and throat. High concentrations in air may be narcotic and depress the central nervous system with symptoms including nausea, vomiting, headache, dizziness, drowsiness, weakness, loss of consciousness, and possibly death. Headache and throat irritation may occur at levels as low as 300 ppm in air.
Hazards of Ingestion: Moderately toxic, but specific details are unavailable. Expect irritation of the mouth and throat and possibly symptoms of ingestion among others.

FIRE HAZARDS

Lower Flammable Limit: 1.8%
Upper Flammable Limit: 11.5%
Behavior in Fire: Flammable liquid. May generate quantities of flammable vapor upon release. Vapors are heavier than air and may travel some distance to a source of ignition and flash back. There is some limited possibility that containers may rupture violently in fire.
Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

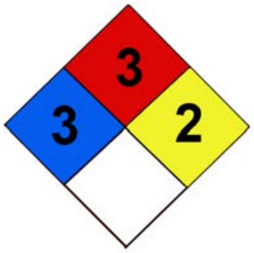
Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some limited possibility that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 30,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (30,000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1193

METHYL ETHYL KETONE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, or throat; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the volatility and flammability of methyl ethyl ketone into account while planning the spill response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl ethyl ketone spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Methyl ethyl ketone may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of methyl ethyl ketone in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

METHYL ETHYL KETONE

Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb methyl ethyl ketone vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of methyl ethyl ketone from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of methyl ethyl ketone vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid methyl ethyl ketone may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methyl ethyl ketone may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained methyl ethyl ketone may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

METHYL ETHYL KETONE
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

METHYL ETHYL KETONE
Class 3 (Flammable Liquid)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary. (Note: Carbon may not be highly effective.)

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

METHYL FLUORIDE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Methyl fluoride is a colorless and flammable liquefied compressed gas with an odor resembling ether. It is used in propellant mixtures and in scientific investigations. Being slightly soluble in water and lighter, liquid methyl fluoride spills on water will rapidly boil off with only small amounts dissolving. Vapors of the product are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration.The liquid weighs approximately 7.3 pounds per gallon near its boiling point and approximately 4.65 pounds per gallon at 77°F when under its own pressure.

Methyl fluoride does not react with water violently, but there is an uncertain and unconfirmed possibility that slow hydrolysis in water may produce highly corrosive hydrofluoric acid. The product is stable in transportation, noncorrosive to common metals when dry, and known to be incompatible with oxidizing agents and chemically active metals such as potassium, powdered aluminum, magnesium, and zinc. Vapors may be present in air at high concentrations, and although not formally studied, are generally considered to be of relatively low toxicity. Contact with the liquid or cold gas streams may result in frostbite and possible irritation. Products of combustion are toxic and corrosive and may include hydrogen fluoride, carbonyl fluoride, fluorine, and carbon monoxide.

Downwind evacuation should be considered if large amounts of methyl fluoride are leaking (not on fire) until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently. (Note: Due to its limited use in industry, little information is generally available on the characteristics of methyl fluoride. Be advised that many of the recommended spill response procedures in this guide were derived via analogy of the product with related materials such as methyl chloride.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 166 cc of gas/100 g water at 59°F (15°C)

Solubility in Other Chemicals: Soluble in alcohol and ether

Specific Gravity (Liquid): 0.877 at –108.4°F (–78°C); 0.557 at 77°F (25°C)

Boiling Point: –109.1 to –108.8°F (–78.4°C to –78.2°C) at 1 atm.

Melting Point: –223.2°F (–141.8°C)

Freezing Point: See melting point

Molecular Weight: 34.0

Heat of Combustion: Unavailable

Vapor Pressure: 37.6 atm (552.7 psia) at 70°F (21.1°C)

Flash Point: Flammable gas

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Noncorrosive to common metals except as noted below when dry. May eventually become corrosive in presence of water or moisture (see below).

Reactivity with Water: There is a possibility reported that slow hydrolysis in water may produce highly corrosive hydrofluoric acid but this is uncertain and unconfirmed.

Reactivity with Other Chemicals: Known to be incompatible with oxidizing agents and chemically active metals such as potassium, powdered aluminum, magnesium, and zinc.

IDENTIFICATION

Shipping Names: Methyl fluoride (USDOT and IMO); Refrigerated gas R 41 (USDOT).

Synonyms and Tradenames: Fluoromethane

Chemical Formula: CH_3F

Constituent Components (% each): Unavailable; likely to be relatively pure

UN/NA Designation: UN2454

IMO Designation: 2.1, flammable gas

Physical State as Shipped: Liquefied compressed gas

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas

Odor Characteristics: Like ether; agreeable

Common Uses: Propellant mixtures; study of carbonfluorine bonds.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

METHYL FLUORIDE
Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Flammable liquefied compressed gas with heavier than air vapors that may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact with very cold liquid, gas, or containers.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct physical contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with liquid methyl fluoride or cold venting gas may result in frostbite and possible irritation.

Hazards of Inhalation: Methyl fluoride is considered to be relatively nontoxic but has not been formally studied. Inhalation of high concentrations in air are expected to cause central nervous system depression and narcosis with symptoms such as dizziness, disorientation, incoordination, nausea, or vomiting. Very high concentrations may cause asphyxiation and possibly death due to displacement of oxygen in air.

Hazards of Ingestion: Due to its low boiling point, ingestion of methyl fluoride is considered unlikely.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquefied compressed gas. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flashback. Containers may rupture violently in fire. Flame is relatively colorless like that of alcohol.

Hazardous Combustion Products: Toxic and corrosive; may include hydrogen fluoride, carbonyl fluoride, fluorine, and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. One authority states that the product "can detonate or explode under strong initiating source, or after contacting water and heating under confinement." The validity and exact meaning of these statements are not clear.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent skin contact with cold methyl fluoride or cold containers and any reasonable probability of eye contact with the cold product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus(SCBA) may be advisable in some cases to prevent contact with high concentrations of combustion products in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2454

METHYL FLUORIDE

Division 2.1 (Flammable Gas)

FIRST AID

Nonspecific Symptoms: Frostbite; any symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing. Do not use hot water on frost bitten areas and do not rub frozen tissues.

FIRE RESPONSE

Extinguishing Materials: Stop flow if possible or else allow fire to burn out while cooling surroundings with water spray. Carbon dioxide, dry chemical, or water spray may be used for extinguishment when reignition is no longer possible. Note that contact of water with pools of liquid methyl fluoride may increase vapor evolution.

Extinguishing techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Electrically ground and bond lines and equipment as necessary. Take the highly volatile, flammable, and heavier than air nature of methyl fluoride into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl fluoride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases if large quantities are released.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to methyl fluoride vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid methyl fluoride as this may increase gas or vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of methyl fluoride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

METHYL FLUORIDE
Division 2.1 (Flammable Gas)

TECHNIQUE

FOAM ... There is a possibility that an appropriate firefighting foam applied to the surface of quiescent liquid pools may slow the release of methyl fluoride vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid methyl fluoride or contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment if pure liquid methyl fluoride is involved.

MITIGATION

Use compatible equipment with proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines. (Note: Most residues will rapidly evaporate.)

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

METHYL FLUORIDE
Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Most methyl fluoride will rapidly vaporize from the surface of a water body with little dissolution. The significance of any contamination and the need for containment and treatment must be determined on a case-by-case basis. Consult qualified experts where necessary.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1990

METHYL FORMATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl formate is a colorless and highly volatile liquid with a pleasant; agreeable odor that has been described as being fruity and also resembling ether. It is used as a solvent, as a fumigant and larvicide, as a refrigerant, and for making various organic chemicals. It is very soluble in water and will mix and dissolve rapidly. A boiling point of 88.7–89.8°F and a flash point that has been reported to be as low as –32°F indicate that methyl formate is easily ignited under all ambient temperature conditions. Vapors of methyl formate are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.1 pounds per gallon.

Methyl formate reacts slowly with water to form formic acid and methanol (methyl alcohol) in a reaction that is not hazardous. It is stable in normal transportation and not reactive with many other common materials. It may react vigorously or ignite in contact with strong oxidizing agents, however, and reacts with methyl alcohol and sodium methoxide to form an explosive substance. Methyl formate is noncorrosive to metals but may attack some types of plastics, rubber, and coatings. Toxicity by all potential routes of exposure is generally low to moderate but the volatility of methyl formate indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

If methyl formate is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; approx. 30 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in almost all conventional organic solvents such as alcohols, ethers, and esters.

Specific Gravity (Liquid): 0.97–0.98 at 68°F (20°C)

Boiling Point: 88.7–89.8°F (31.5–32.1°C) at 1 atm.

Melting Point: –148.4 to –146.2°F (–100.2 to –99°C)

Freezing Point: See melting point

Molecular Weight: 60.05

Heat of Combustion: –3880 cal/g

Vapor Pressure: 476–480 mm Hg (9.200–9.278 psia) at 68°F (20°C)

Flash Point: Reported values vary from –32°F (–35.6°C) to 1.4°F (–17°C) via various types of flash point measurement methods.

Autoignition Temperature: 840–869°F (449–465°C)

Burning Rate: 2.5 mm/minute

Stability: Stable

Corrosiveness: Noncorrosive to metals but may attack some types of plastics, rubber, and coatings.

Reactivity with Water: Slow reaction to form formic acid and methanol (methyl alcohol); reaction is not hazardous. Formic acid has a Reportable Quantity (RQ) of 5000 lbs/2270 kgs that is subject to change. Refer to EPA regulations for current reporting requirements if large amounts of formic acid are formed under spill conditions.

Reactivity with Other Chemicals: May react vigorously or ignite in contact with strong oxidizing agents. Reacts with methanol and sodium methoxide to form an explosive product.

IDENTIFICATION

Shipping Names: Methyl formate (USDOT and IMO)

Synonyms and Tradenames: Methyl methanoate; formic acid, methyl ester

Chemical Formula: $HCOOCH_3$

Constituent Components (% each): 97% or more pure

49 STCC: 49 082 25

UN/NA Designation: UN1243

IMO Designation: 3.1, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid, boiling liquid, or gas (boils at 88.7–89.8°F)

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant; agreeable; like ether; fruity

Common Uses: Solvent; fumigant and larvicide; refrigerant; organic synthesis of pharmaceuticals, dyes, embalming fluids, and military poison gases

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

METHYL FORMATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1500–2000 ppm

Unusual Hazards: Highly volatile and flammable liquid with heavier than air vapors that may persist in pits, hollows, and depressions. Methyl formate may boil at higher ambient temperatures.

Short Term Exposure Limits (STEL): 150 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV TWA): 100 ppm over each 8 hours of a **40 h**our work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and some distance downwind. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid methyl formate may result in drying and cracking of the skin as well as irritation due to the defatting action of the product. There is evidence that the liquid can be absorbed through the skin in toxic amounts. Contact of the liquid with the eyes may cause irritation. Do not wear contact lenses when working with methyl formate.

Hazards of Inhalation: Exposure to methyl formate vapors in air may result in irritation of the eyes, nose, throat, and lungs. Inhalation of high concentrations in air may cause temporary disturbances of vision as well as narcosis and central nervous system depression with symptoms including chest oppression, incoordination, difficult breathing, stupor, retching, nausea, headache, pulmonary edema, convulsions, unconsciousness, and possibly death in severe cases. Pulmonary edema may possibly be delayed in onset. Exposure of guinea pigs to 50,000 ppm for 30 minutes, 25,000 ppm for 60 minutes, or 10,000 ppm for three hours was lethal to the animals in laboratory experiments. All animals survived exposure to 3500 ppm for eight hours.

Hazards of Ingestion: Methyl formate is of relatively low toxicity by ingestion. Nevertheless, excessive ingestion may result in irritation of the mouth and stomach, severe gastric upset, and many of the effects of inhalation, including effects on vision, and possibly death. Although not reported in the literature, characteristics of the product suggest the possibility that aspiration of the concentrated liquid into the lungs during vomiting may have the potential to cause pulmonary edema with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: Most say 5% but 4.5% and 5.9% have also been reported.

Upper Flammable Limit: Most say 22.7–23% but 20% has also been reported.

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined; reported to produce acrid smoke, irritating fumes, carbon monoxide, carbon dioxide, formic acid, and possibly other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas-tight or splash-proof safety goggles as needed, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1243

METHYL FORMATE
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, respiratory tract, or skin; disturbance of vision or symptoms of narcosis and central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: This is the recommendation made by several noted authorities. Be advised, however, that some sources do not recommend induction of vomiting. Seek immediate medical advice on this issue if possible, realizing that both courses of action pose various risks to the victim.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, Halon, alcohol foam, water spray. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of methyl formate may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment. Take into account while planning the response that methyl formate is a highly volatile and flammable liquid with heavier than air vapors.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl formate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow. vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYL FORMATE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl formate vapors may absorb vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of methyl formate, formic acid, and methyl alcohol from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of methyl formate vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to liquid methyl formate may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methyl formate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained methyl formate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

METHYL FORMATE
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, saw dust, straw, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Methyl formate will mix rapidly with water and react slowly to produce formic acid and methanol, both of which are soluble in water in all proportions. Formic acid is considered to be corrosive. See the Emergency Action Guide for methanol for further information about that product.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

METHYL FORMATE
Class 3 (Flammable Liquid)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards posed by the formation of formic acid.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of various chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

METHYLHYDRAZINE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Methylhydrazine is a colorless, fuming, highly reactive, corrosive, flammable, and highly toxic liquid that has a fishy, ammonia-like odor. It is used as a rocket fuel, as a solvent, and as an organic intermediate in the making of other chemical substances. It is fully soluble in water and will mix freely. Its lowest reported flash point of 17°F indicates that the product may easily be ignited under most ambient temperature conditions. Vapors and fumes may be somewhat heavier than air, particularly at higher ambient temperatures, and may in any case travel some distance to a source of ignition and flash back. Accumulations of vapors in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration due to spontaneous decomposition of the product. Unusual flammability characteristics include an upper flammable limit that has been reported to be as high as 99%, indicating that methylhydrazine may burn in the virtual absence of air. Liquid methylhydrazine weighs approximately 7.3 pounds per gallon.

Methylhydrazine does not react with water and is stable in normal transportation at ordinary ambient temperatures. It is a very strong reducing agent, however, that may spontaneously ignite in air in contact with porous materials such as earth, wood, cloth or asbestos, and that may ignite, explode, or react with a wide variety of other substances including rusty metals and oxidizing agents. Toxicity of the product is high by all routes of exposure and the material is corrosive to bodily tissues. Products of combustion include toxic nitrogen oxides, carbon monoxide, carbon dioxide, ammonia, and possibly other toxic constituents.

If methylhydrazine is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in ether, hydrazine, hydrocarbons, and monohydric alcohols.

Specific Gravity (Liquid): 0.874 at 68°F (20°C)

Boiling Point: 189.5°F (87.5°C) at 1 atm.

Melting Point: – 62.3°F (– 52.4°C)

Freezing Point: See melting point

Molecular Weight: 46. 1

Heat of Combustion: – 6766 cal/g

Vapor Pressure: 36 mm Hg (0.6958 psia) at 68°F (20°C)

Flash Point: 17°F (– 8.3°C), closed cup; 62 – 70°F (16.7 – 21.1°C) open cup

Autoignition Temperature: 382 – 385°F (194.4 – 196°C)

Burning Rate: 2.0 mm/minute

Stability: Stable in normal transportation if not in contact with iron, copper, or their alloys. Absorbs water and carbon dioxide from air, slowly decomposes and is therefore shipped in sealed containers under a nitrogen atmosphere. As many as 17 different decomposition products have been identified in air with primary constituents including formaldehyde methane, nitrogen, water, and methylhydrazone depending upon the surfaces being contacted by the reactants. The half life of methyl hydrazine vapors ranges from 2 to 7 hours in confinement when mixed with air.

Corrosiveness: Use glass or stainless steels, except those containing 0.5% or more molybdenum. Methylhydrazine is highly reactive with several metallic oxides. Avoid contact with iron, copper manganese, molybdenum, lead, their alloys, and other catalytic metals and alloys (possibly but not necessarily including cadmium, cobalt, gold, silver, and zinc).

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Contact with porous materials such as wood, asbestos, cloth, or earth may result in spontaneous ignition. Ignites spontaneously upon contact with many oxidizers such as hydrogen peroxide, nitrogen tetroxide, fluorine, chlorine trifluoride and other halogen fluorides, and fuming nitric acid. May ignite or explode in contact with metallic oxide (rusty) surfaces. Methylhydrazine is a strong reducing agent that may react with a wide variety of other chemicals and catalytic metals (see section on Corrosiveness).

IDENTIFICATION

Shipping Names: Methylhydrazine (USDOT and IMO)

Synonyms and Tradenames: Monomethylhydrazine; 1-methylhydrazine, hydrazomethane, MMH

Chemical Formula: CH_3NHNH_2

Constituent Components (% each): 98% or more pure

UN/NA Designation: UN1244

IMO Designation: 6.1, poisonous substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless fuming liquid

Odor Characteristics: Like ammonia or amine; fishy

Common Uses: Rocket propellant; solvent; organic intermediate

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYLHYDRAZINE

Division 6.1 (Poisonous Material)

Square background applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 1–3 ppm

Unusual Hazards: Fuming, highly reactive, flammable, corrosive, and highly toxic liquid. Vapors or fumes may travel to a source of ignition and flash back. Methylhydrazine may continue to burn in the virtual absence of air.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): (Skin) 0.2 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the toxic vapor concentrations that may be present in the spill area and over considerable downwind distances. Ingestion and physical contact are also to be strictly avoided. Methylhydrazine is suspected of being a human carcinogen in long term occupational exposures and is also known to cause fetal abnormalities in animals and to be mutagenic.

Hazards of Skin or Eye Contact: Liquid methylhydrazine is corrosive to the skin, may be rapidly absorbed through the skin in toxic amounts to produce many of the symptoms of inhalation (including swelling of the eyes known as corneal edema), and may possibly cause allergic skin sensitization. Contact of the liquid with the eyes may also be extremely harmful and lead to temporary and possibly permanent blindness.

Hazards of Inhalation: Methylhydrazine vapors are irritating to the eyes, nose, and throat. Overexposure via inhalation is reported to cause central nervous system and other toxic effects including dizziness, incoordination, nausea, vomiting, diarrhea, frequent urination, rapid respiration, various blood abnormalities involving blood cell destruction, anemia and cyanosis, tremors, convulsions, corneal edema leading to temporary blindness, kidney damage, pulmonary hemorrhage and edema, and possibly death. Some effects such as corneal edema and pulmonary edema may be delayed in onset. Exposure of humans to 90 ppm for 10 minutes caused tickling of the nose, nasal drip, mild to medium eye irritation, and an unpleasant taste sensation. Exposure to 82 ppm for one hour was lethal to 50% of monkeys in laboratory experiments.

Hazards of Ingestion: Methylhydrazine is highly toxic by ingestion, causing many of the systemic effects reported for inhalation.

FIRE HAZARDS

Lower Flammable Limit: 2.5%

Upper Flammable Limit: 92 – 99%; reported values vary

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors may travel some distance to a source of ignition and flash back. Containers may rupture violently and or explode in fire.

Hazardous Combustion Products: May include highly toxic nitrogen oxides, ammonia, carbon monoxide, carbon dioxide, and possibly other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently or explode in fire. Contact with certain other chemicals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

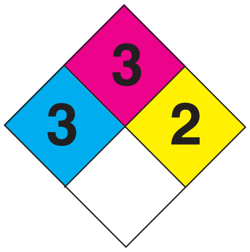
Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus may be necessary to prevent contact with high vapor or fume concentrations in air. Potentially compatible materials listed by various authorities include butyl rubber, polyvinyl chloride (PVC), chlorobutyl rubber, CR 39, and Viton.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 0.2 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1244

METHYLHYDRAZINE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; dizziness, nausea, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical and/or water. Due to its wide flammability limits, low flash point, and reignition hazard, dilution of methylhydrazine spills to nonflammable mixtures by large amounts of water is the response of choice for large fires.

Extinguishing Techniques: Unusual toxic vapor and fume hazard. Stay upwind. Avoid bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture, or explosion of boilers or industrial process equipment. Use explosion-proof and spark-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the highly toxic, flammable, and reactive nature of methylhydrazine into account while planning the response. Where possible, store recovered methylhydrazine in closed containers under a nitrogen atmosphere.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent public exposure and to allow vapors or fumes to dissipate. Methylhydrazine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYLHYDRAZINE

Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methylhydrazine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain methylhydrazine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of methylhydrazine vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid methylhydrazine may slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid methylhydrazine after its dilution with water may further slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methylhydrazine may be contained by building dikes using dry sand, clay, bentonite, or other nonporous and noncombustible materials.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

METHYLHYDRAZINE
Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, clay, bentonite, diatomite, or similar nonporous and noncombustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

METHYLHYDRAZINE

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Methylhydrazine is fully soluble in water and will rapidly dissolve. Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2003

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Methyl isobutyl carbinol (MIBC) is typically a clear, flammable liquid with a mild odor, however, at least one manufacturer reports shipping it as a green product. It is a solvent for ethyl cellulose and certain phenolics as well as many oils, dyes, gums and natural resins. Methyl isobutyl carbinol is miscible with organic solvents, but has only limited solubility in water, so may be expected to form a floating surface slick that dissolves. It has a flash point of 106°F and therefore flammable, but it can be identified as a flammable or combustible liquid when in transportation. It’s flash point of 106°F indicates that it may be easily ignited at warmer ambient temperatures. It is stable under normal conditions and will not polymerize but is reactive with strong acids and oxidizing agents. MIBC has a vapor pressure of 2.8 mm Hg at 68°F, making it a moderate hazard at normal ambient temperatures. Vapors are heavier than air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers. Products of combustion may include toxic gases. The product weighs approximately 6.7 pounds per gallon.

Prolonged or repeated contact causes defatting of the skin with irritation, dryness and cracking. Exposure may cause central nervous system depression and irritation of the eyes, skin and mucous membranes. Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of methyl isobutyl carbinol is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; 1.50 g/100 mL
Solubility in Other Chemicals: Organic solvents
Specific Gravity (Liquid): 0.807
Vapor Density: 3.5
Boiling Point: 270°F (132°C)
Melting Point: -130°F (-90°C)
Freezing Point: See melting point
Molecular Weight: 102.176
Evaporation Rate (butyl acetate=1): 0.43
Vapor Pressure: 2.8 mm Hg at 68°F (20°C)
Flash Point: 106°F (41°C)
Autoignition Temperature: Reports vary slightly, 546.8°F (286°C) to 581°F (305°C)
Heat of Combustion: 36407 kJ/kg
Burning Rate: Unavailable
Flammable Limits: 1% (LFL) - 5.5% (UFL)
Stability: Stable under normal conditions
Polymerization Potential: Will not occur
pH: 7
Reactivity with Water: None
Reactivity and Incompatibility: Oxidizing agents (such as perchlorates, peroxides, permanganates, chlorates, nitrates, chlorine, bromine and fluorine), strong acids (such as sulfuric acid, hydrochloric acid and nitric acid) or acid chlorides.

IDENTIFICATION

Shipping Name(s): Methyl Isobutyl Carbinol (USDOT & IMO)
Synonyms and Tradenames: 2-Methyl-4-pentanol; 4-Methyl-2-pentanol; 4-Methylpentan-2-ol; 4-Methylpentanol-2; Isobutylmethylcarbinol; Methyl-2-pentanol; Methylamyl alcohol; Methylpentanol; M.I.B.C.; Pentanol, 4-methyl-; sec-Hexyl alcohol
CAS Registry No.: 108-11-2
Chemical Formula: $C_6H_{14}O$
Constituent Components (% each): Typically 93% to 100% pure
UN/NA Designation: UN2053
IMO Designation: 3, Flammable liquids
RTECS Number: SA7350000
NFPA 704 Hazard Rating: 2 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear, colorless liquid. At least one manufacturor ships it as a green liquid.
Odor Characteristics: Mild odor
Common Uses: It is used as a solvent and in brake fluids; used in lacquers to improve gloss, flow out and blush resistance, and in the preparation of phenolic and alkyd-amine baking finishes; used as a hydraulic fluid component, as a frothing agent in ore flotation, as a chemical intermediate and in the manufacture of pharmaceuticals, photographic reagents and industrial cleaning compounds.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or
Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Product is flammable. Fumes and vapors are heavier than air, may travel to a distant source of ignition and flash back.

Short Term Exposure Limit (STEL): 40 ppm (167 mg/m^3) (NIOSH & ACGIH)

Time Weighted Average (TLV-TWA): 25 ppm (104 mg/m^3) (NIOSH & ACGIH)

Ceiling (C) Limit: Unavailable

IDLH: 400 ppm

Conditions to Avoid: Heat or sources of ignition; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to the high vapor concentrations that may be present in the local spill area and immediately downwind.

Hazards of Skin or Eye Contact: May cause skin and eye irritation. Prolonged and/or repeated contact causes defatting of the skin with irritation, dryness, cracking or folliculitis. Can be absorbed through the skin.

Hazards of Inhalation: May cause respiratory tract irritation. High concentrations causes central nervous system effects, such as dullness, dizziness and anesthesia.

Hazards of Ingestion: May cause gastrointestinal irritation with nausea, abdominal pain, vomiting, diarrhea, headache and dullness.

FIRE HAZARDS

Lower Flammable Limit: 1%

Upper Flammable Limit: 5.5%

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas and may travel to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: May include carbon monoxide, carbon dioxide and irritating and toxic fumes and gases.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

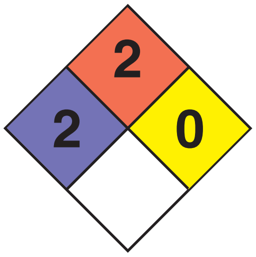
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: Up to 250 ppm (APF = 10), any supplied-air respirator. Up to 400 ppm, any supplied-air respirator operated in a continuous-flow mode (APF = 25), any self-contained breathing apparatus with a full facepiece (APF = 50), or any supplied-air respirator with a full facepiece (APF = 50). For unknown concentrations, fire fighting or high concentrations (above 400 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2053

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Defatting of the skin with irritation, dryness and cracking. May cause central nervous system depression. May cause eye, skin, respiratory and digestive tract irritation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if irritation develops or persists. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Seek medical advice on whether or not to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, alcohol-resistant foam, water spray, fog or carbon dioxide.

Extinguishing Techniques: Toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Do not use a solid stream of water, since the stream may scatter and spread the fire. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: Methyl isobutyl carbinol is a flammable liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or Combustible Liquid

AIR RELEASE

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic and/or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Alcohol-resistant foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Spills may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible, impervious material.

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

NOTE: The techniques described below are for floating, undissolved liquids. Due to the fact that some amount of the chemical is expected to dissolve, other techniques should be considered, such as containment dikes, aeration and adsorption.

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

METHYL ISOBUTYL CARBINOL

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Sorbent pads or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating product.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Sorbent pads, peat or commercial sorbent materials compatible with product may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

March 1995

METHYL ISOBUTYL KETONE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl isobutyl ketone is a clear colorless flammable liquid that is used as a solvent, as an alcohol denaturant, and for making methyl amyl alcohol. It is of low but significant solubility in water and lighter, so may be expected to form a floating slick that dissolves at a moderate rate. Its flash point range of 64-75°F indicates that it can be easily ignited at warmer ambient temperatures. Vapors are only slightly heavier than air at or above these temperatures but may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some limited potential that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.7 pounds per gallon.

Methyl isobutyl ketone does not react with water or many other common materials and is stable in normal transportation. It is reactive with strong oxidizers, however, and may soften a variety of plastics. Toxicity of the product is low to moderate via the various potential routes of exposure. Products of combustion are irritating and may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Somewhat soluble, 2 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, benzene, chloroform, diethyl ether, and ethyl alcohol.
Specific Gravity (Liquid): 0.802 at 68°F (20°C)
Boiling Point: 241.2°F (116.2°C) at 1 atm.
Melting Point: See freezing point
FreezingPoint: –119°F (–84°C)
Molecular Weight: 100.16
Heat of Combustion: –5800 cal/g
Vapor Pressure: 5 mm Hg (0.097 psia) at 67.5°F (20°C)
Flash Point: 64-73°F (17.8-22.8°C), closed cup; 75°F (23.9°C), open cup.
Autoignition Temperature: 840-860°F (448-460°C)
Burning Rate: Unavailable
Stability: Stable
Corrosiveness: Noncorrosive but may soften many plastics.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizing materials.

IDENTIFICATION

Shipping Names: methyl isobutyl ketone (USDOT and IMO).
Synonyms and Tradenames: 4-Methyl-2-pentanone; isobutyl methyl ketone; hexone; isopropyl acetone; MIK; MIBK; 4-methyl-2-oxopentane; 2-methyl-4-pentanone.
Chemical Formula: $(CH_3)_2CHCH_2COCH_3$
Constituent Components(% each): More than 95% pure by weight
UN/NA Designation: UN1245
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pleasant, mild or sharp, ketonic, like mint
Common Uses: Solvent for vinyl resins, camphors, oils, fats, waxes, paints, varnishes, lacquers, etc; alcohol denaturant; uranium extraction solvent; mfg. methyl amyl alcohol.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYL ISOBUTYL KETONE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.48-8 ppm

Unusual Hazards: None

Short Term Exposure Limits(STEL): 75 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 50 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations that may be present in the immediate spill area. Direct contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid methyl isobutyl ketone may cause drying, cracking, inflammation, and peeling of the skin due to the defatting action of the product. Contact with the eyes may result in pain and irritation.

Hazards of Inhalation: Vapors of methyl isobutyl ketone may be irritating to the eyes, nose, and throat. High concentrations in air may cause narcosis and central nervous system depression with symptoms including headache, nausea, drowsiness, dizziness, staggering gait, unconsciousness, and possibly death. Prolonged exposure to 100 ppm may cause headache and nausea. Exposure of rats to 4000 ppm in air for 4 hours was fatal in laboratory experiments.

Hazards of Ingestion:

Data unavailable. Product is of relatively low oral toxicity in animal experiments.

FIRE HAZARDS

Lower Flammable Limit: 1.4%

Upper Flammable Limit: 7.5%

Behavior in Fire: Flammable liquid. May generate some quantity of flammable vapors upon release. Vapors may be heavier than air at warmer temperatures and may travel to a source of ignition and flash back. There is some limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined but considered irritating; may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

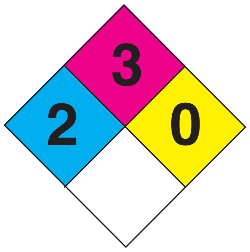
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, polyethylene, polyurethane, polyvinyl alcohol, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 3000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin style or front or back mounted organic vapor canister (3000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1245

METHYL ISOBUTYL KETONE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, nose, throat, or skin; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers, confined spaces, or waterways. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of methyl isobutyl ketone may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that methyl isobutyl ketone is a flammable liquid. Note that oil spill containment and cleanup techniques described for water spills are only effective before the spilled product dissolves in water.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Methyl isobutyl ketone may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of methyl isobutyl ketone in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl isobutyl ketone vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of methyl isobutyl ketone from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

METHYL ISOBUTYL KETONE
Class 3 (Flammable Liquid)

TECHNIQUE

ALCOHOL FOAM . . . There is a posssibility that alcohol foam applied to the surface of liquid pools may slow the release of methyl isobutyl ketone vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methyl isobutyl ketone may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained methyl isobutyl ketone may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

METHYL ISOBUTYL KETONE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

METHYL ISOBUTYL KETONE

Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating methyl isobutyl ketone.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with methyl isobutyl ketone may be used to absorb spilled product from the watersurface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

METHYL ISOCYANATE
Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Methyl isocyanate, often called MIC for short, is a colorless, flammable, highly toxic liquid with a boiling point of 102.4ºF and a sharp pungent odor that causes tears in the eyes. It is a general chemical intermediate used to make carbamate insecticides and herbicides. It is fairly soluble in water and slightly lighter, and will react with water in a complex manner discussed below. Its flash point of less than 0ºF indicates that it may be easily ignited under virtually all ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently and possibly explode if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.1 pounds per gallon.

Methyl isocyanate reacts with water to form methylamine (see separate guide for methylamine) and other substances described below. The product will also decompose on contact with alkali or acids and may polymerize while evolving heat in the presence of zinc, iron, tin, copper, salts of these metals, and other catalysts such as triphenylarsenic oxide, triethylphosphine, tributylin oxide, calcium oxide, sodium alkoxides, and ferric, tin, or copper chlorides. Such reactions will proceed violently or slowly depending on the specific catalyst involved. Toxicity of the volatile product is extremely high by all routes of exposure and its vapors in air can be lethal or otherwise harmful over considerable downwind distances. Thermal decomposition of MIC may produce hydrogen cyanide, nitrogen oxides, carbon monoxide, and possibly some amounts of unburned material. Only certain materials of construction listed below are safe in contact with MIC.

Downwind evacuation should be considered immediately if methyl isocyanate is leaking from its container but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently or explode.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Most reported is 6.7% wt or 6.7 g/100g water at 68ºF (20ºF). Note that MIC reacts with water.
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 0.96 at 68ºF (20ºC)
Vapor Density: 2.0
Boiling Point: 102.4ºF (39.1ºC) at 1 atm
Melting Point: -112ºF (-80ºC) or less
Freezing Point: See melting point
Molecular Weight: 57.05
Heat of Combustion: 4463 - 4722 cal/g
Evaporation Rate (butyl acetate=1): 26.8
Vapor Pressure: 348 mmHg (6.73 psia) at 68ºF (20ºC)
Flash Point: Less than 0ºF (-17.8ºC), open cup; 19 - 20ºF (-7.2 to -6.7ºC), closed cup.
Autoignition Temperature: 994 - 995ºF (534 - 535ºC)
Burning Rate: Unavailable
Flammable Limits: 5.3% (LEL) - 26% (UEL)
Stability: Can become unstable.
Polymerization Potential: Elevated temperatures. See general information section for polymerization catalysts to be avoided.
Corrosiveness: Do not use iron, steel, aluminum, zinc, galvanized iron, copper or tin or their alloys as these may initiate polymerization reactions. Suitable materials include types 304 and 316 stainless steel, nickel, pinhole free glass-lined steel, and fluorocarbon resins such as Teflon or Kel-f. Any other material may be unsuitable and possibly dangerous. MIC diffuses through polyethylene and attacks most elastomers.
Reactivity with Water: Reacts with water to produce carbon dioxide, methylamine, dimethylurea and/or trimethylbiuret accompanied by evolution of heat which may cause evaporation of the isocyanate. The reaction is relatively slow below 68ºF (20ºC) but becomes violent at more elevated temperatures or in the presence of acids or bases.
Reactivity and Incompatibility: Other incompatible substances include oxidizers and compounds such as alcohols, amines, acids, and urea derivatives that possess active hydrogen atoms.

IDENTIFICATION

Shipping Name(s): Methyl isocyanate (USDOT & IMO); Methyl isocyanate solution (IMO).
Synonyms and Tradenames: Isocyanatomethane; Methylcarbylamine; Isocyanic acid, Methyl ester; Methyl carbonimide; MIC.
CAS Registry No.: 624-83-9
Chemical Formula: CH_3NCO or C_2H_3NO
Constituent Components (% each): Relatively pure when shipped as methyl isocyanate (MIC).
UN/NA Designation: UN2480
IMO Designation: 6.1, Toxic substances
RTECS Number: NQ9450000
NFPA 704 Hazard Rating: 4(Health): 3(Flammability): 2(Reactivity): Reacts with water
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid (boils at 102.4ºF or so)
Color of the Shipped Material: Colorless liquid
Odor Characteristics: Sharp, causes tears; pungent.
Reportable Quantity: See appendix I.
Common Uses: Mfg. carbamate insecticides, herbicides; general chemical intermediate.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHYL ISOCYANATE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: No odor at 2 ppm but irritation and intense tearing occurs in 5 minutes.

Unusual Hazards: Highly toxic, reactive, volatile, and flammable substance. Containers may rupture violently in fire. Flammable vapors may travel to a source of ignition and flash back. Discharges into the atmosphere due to spills or potential runaway polymerization reactions can subject downwind areas to highly toxic concentrations in air over considerable distances.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.02 ppm (Skin)

Ceiling (C) Limit: Unavailable

IDLH: 3 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Dangerous by all routes of exposure. The major hazard is from the significant and extremely toxic vapor concentrations that may occur in the spill area and over considerable downwind distances, particularly in the event of a runaway exothermic reaction. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of liquid methyl isocyanate with the skin or eyes may result in severe burns and tissue destruction. The substance may be absorbed through the skin in toxic amounts. Eye contact may result in permanent damage. Vapors may also irritate the skin and eyes, with a substantial potential for temporary corneal injury.

Hazards of Inhalation: The vapors of methyl isocyanate cause intense lacrimation and irritation of the eyes, mucous membranes, and skin. High concentrations in air can cause headache, nausea, vomiting, coughing, difficult breathing, increased secretions, chest pain, pulmonary sensitization in susceptible individuals, delayed pulmonary edema, edema of the larynx and bronchi, spasm, and death. Exposure to only 5 ppm in air was fatal to 50% of rats within four hours in laboratory experiments. Humans experience marked irritation of the eyes, nose, and throat within 1 to 5 minutes at 4 ppm in air, with symptoms being less severe at 2 ppm and unbearable at 21 ppm. Some symptoms such as light sensitivity, coughing, difficult breathing, fatigue, dizziness, skin rashes, and others may reoccur.

Hazards of Ingestion: Ingestion of methyl isocyanate may be fatal. At the very least, burns of the mouth, throat, and stomach may be expected.

FIRE HAZARDS

Lower Flammable Limit: 5.3%

Upper Flammable Limit: 26%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapors upon release. Vapors may be heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire and possibly explode. Unburned vapors may pose toxic hazard over considerable downwind distances.

Hazardous Combustion Products: Thermal decomposition may produce hydrogen cyanide, nitrogen oxides, carbon monoxide, and/or carbon dioxide. Some amounts of unburned methyl isocyanate may be included.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire and possibly explode. Contamination of product by various substances may occasionally initiate a potentially rapid polymerization reaction that may lead to violent container rupture and release of highly toxic gases. The product may explode violently when dropped on a hot surface; dried out MIC may explode if exposed to heat, flame, or shock.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Polyvinyl ACL is reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with hazardous vapor or fume concentrations in air under accident conditions. A MIC product bulletin suggests that the "butyl type" be used.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 0.02 ppm), a self-contained breathing apparatus (SCBA) with full facepiece.

2480

METHYL ISOCYANATE

Division 6.1 (Poisonous Materials)

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues and the respiratory tract; intense tearing of the eyes; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek medical attention immediately if skin irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide; use water spray or foam with caution due to the possibility of increased vapor evolution. Note that it may be best at times not to extinguish burning MIC due to toxic vapor and reignition hazards.

Extinguishing Techniques: Unusual corrosive and toxic vapor hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus. Wear full chemical protective suit if contact with material or fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800ºF), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Take into consideration the highly toxic nature of methyl isocyanate while planning the response. Downwind evacuation should be considered. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Use intrinsically safe equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product, and which will not initiate a reaction. Take the reactivity, flammability, volatility, and high toxicity of methyl isocyanate into account when planning the response.

AIR RELEASE

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYL ISOCYANATE

Division 6.1 (Poisonous Materials)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl isocyanate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Apply water at a point downwind in this case and do not permit it to contact pools of liquid methyl isocyanate as this may increase vapor as the water begins to react with the spill product and the reaction evolves heat. Water runoff may contain a small amount (if any) of methyl isocyanate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of methyl isocyanate vapors into the atmosphere. (Note: Several sources suggest foam use to control fires, thus suggesting that a foam blanket may have value in controlling vapor evolution even though methyl isocyanate is reactive with water.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid methyl isocyanate may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts. Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid methyl isocyanate may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

INTENTIONAL IGNITION . . . Due to the fact that MIC vapors in air were proven to be deadly in the Bhopal tragedy, and are of unusually high toxicity, very careful consideration might be given to the intentional ignition of vapors, particularly if methyl isocyanate vapors are entering the atmosphere at a high rate due to a runaway exothermic reaction of some kind.

CONSEQUENCE

The intentional ignition of a highly flammable substance under uncontrolled conditions can pose several dangers.

MITIGATION

Consult qualified experts if time permits. This response is extreme and is not recommended for casual use by the inexperienced.

METHYL ISOCYANATE

Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Liquid methyl isocyanate may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined methyl isocyanate may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with activated carbon, sand, or other nonreactive and compatible substances. (Note: A product bulletin for MIC suggests that 6 inches of carbon be added to each inch of liquid depth and that the absorbed MIC be allowed to react with moisture in the air over a 12 to 24 hour period.)

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

METHYL ISOCYANATE

Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Methyl isocyanate will react with water to form carbon dioxide, methylamine, dimethylurea, and/or trimethylbiuret.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

METHYL MERCAPTAN
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Methyl mercaptan is a colorless gas shipped as a liquid under pressure and having a strongly offensive, unpleasant odor like that of rotten cabbage or garlic. With a boiling point in the range 42-46°F, a low solubility in water, and a lighter weight, the liquid can be expected to float on water while boiling (in most cases) and slowly dissolving. The very low flash point of the product and its low boiling point indicate that large amounts of flammable (and toxic) vapors or gases may be evolved under most ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.2 pounds per gallon as a liquid.

Methyl mercaptan is stable in normal transportation. Some authorities warn that it reacts with water or steam to form toxic and flammable vapors, but this is somewhat uncertain. The product is known, however, to be reactive with a variety of chemical substances, and it is clear that warm water or steam would at the very least accelerate vapor evolution. Reactions with epoxides may be explosive. A major hazard of spills involves the toxicity of the vapors by inhalation, since they are toxic at low concentrations and large amounts of vapor or gas may be evolved. Products of combustion are toxic and may include sulfur dioxide.

Downwind evacuation should be considered if methyl mercaptan is leaking but not on fire. If a product container is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 2.33 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, and petroleum naphtha

Specific Gravity (Liquid): 0.868 at 68°F (20°C); 0.892 at 42.8°F (6°C)

Boiling Point: 42.4 - 45.7°F (5.8-7.6°C) at 1 atm.

Melting Point: – 186 to – 189.6°F (– 121 to – 123.1°C)

Freezing Point: – 186 to – 189°F (– 121 to – 123°C)

Molecular Weight: 48.1

Heat of Combustion: – 6141 cal/g

Vapor Pressure: 2 atm (29.4 psia) at 79°F (26.1°C)

Flash Point: less than 0°F (– 17.8°C)

Autoignition Temperature: Unavailable

Burning Rate: 3.8 mm/minute

Stability: Stable

Corrosiveness: Normally shipped in steel containers. Avoid copper, mercury, lead, and zinc.

Reactivity with Water: Uncertain; may react with water, or water or steam may simply accelerate vapor evolution.

Reactivity with Other Chemicals: Reacts with bleaches, halogenated organics, isocyanates, ketones, mineral acids, organic peroxides, strong oxidizers, alkali and alkaline earth metals, nitrides, strong reducing agents, epoxides, azo and diazo compounds, hydrazines, unsaturated organics, copper, mercury, lead, and zinc.

IDENTIFICATION

Shipping Names: Methyl mercaptan (USDOT & IMO)

Synonyms and Tradenames: Methanethiol; mercaptomethane; thiomethyl alcohol; methyl sulfhydrate; methylthioalcohol.

Chemical Formula: CH_3SH

Constituent Components(% each): 98-99.5% or more pure with 2% max hydrogen sulfite and traces of dimethylsulfide .

UN/NA Designation: UN1064

IMO Designation: 2.3 poison gas

Physical State as Shipped: Liquid compressed gas

Physical State as Released: Gas or boiling liquid

Color of the Shipped Material: Colorless gas; water-white liquid

Odor Characteristics: Powerful, foul, offensive; like garlic or rotten cabbage.

Common Uses: Mfg. of jet fuel additives, pesticides, fungicides, plastics, dyes, pharmaceuticals, catalysts, and other chemicals

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYL MERCAPTAN

Poison Gas (Division 2.3)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.01-30 ppb (extremely low)

Unusual Hazards: Highly volatile, flammable, and toxic substance. Large amounts of toxic and flammable gases or vapors may be evolved from spills.

Short Term Exposure Limits: OSHA has 10 ppm ceiling limit as 15 minute average.

Time Weighted Average(TLV-TWA): (Skin) 0.5 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of vapors in air, but ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Methyl mercaptan is irritating to the skin and eyes. The liquid may cause frostbite or chemical type burns upon contact.

Hazards of Inhalation: Vapors are irritating to the eyes, nose, and throat and may cause restlessness, increased respiration, cyanosis, muscular weakness, and other symptoms of narcosis or central nervous system depression. High levels may cause respiratory paralysis, convulsions and death. Effects may include pulmonary edema and injury to the liver or kidneys. A level of 4 ppm in air may cause headaches and nausea in several hours. To laboratory rats a concentration of 10,000 ppm is lethal in 1 minute.

Hazards of Ingestion: Can be poisonous. Ingestion may result in irritation of the mouth and stomach plus symptoms described for inhalation.

FIRE HAZARDS

Lower Flammable Limit: 3.9%

Upper Flammable Limit: 21.8%

Behavior in Fire: Flammable liquefied compressed gas. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Toxic, include sulfur dioxide and other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Reactions with epoxides may be explosive.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1064

METHYL MERCAPTAN

Poison Gas (Division 2.3)

FIRST AID

Nonspecific symptoms: Irritation of eyes, nose, and respiratory tract; other symptoms of inhalation or direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. Note that severe pain in eyes due to vapor exposure may be controlled by hot and cold compresses.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to liquid pools may increase rate of vapor evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account during response planning that methyl mercaptan is highly volatile, flammable, and toxic. Beware of possible heavy gas accumulations in pits, hollows, or depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl mercaptan spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

METHYL MERCAPTAN
Poison Gas (Division 2.3)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl mercaptan vapors or fumes from a point downwind of the spill may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a varying amount of methyl mercaptan from contact with airborne vapors or fumes. Any water entering liquid pools of spilled product may increase vapor evolution.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Keep water away from pools of liquid methyl mercaptan.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of quiescent liquid pools may slow the release of methyl mercaptan vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The rate of vapor evolution may increase temporarily as the foam is applied.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if the response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Methyl mercaptan may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained methyl mercaptan may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MTIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. High pressures may be developed in equipment.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

METHYL MERCAPTAN
Poison Gas (Division 2.3)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. The application of sorbent materials may temporarily increase vapor evolution from pools of liquid methyl mercaptan.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. (Note: Vented containers may be necessary.)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water containing dissolved methyl mercaptan may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. (Note: Oil spill containment devices may be considered for floating pools of liquid methyl mercaptan according to some authorities. Proceed with caution if necessary and if attempted.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

METHYL MERCAPTAN
Poison Gas (Division 2.3)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating contaminated water via use of a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

METHYL METHACRYLATE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyl methacrylate is a colorless liquid with a sharp, fragrant, fruity odor. It is used for making plastics and resins. It is slightly soluble in water and slightly lighter, so may be expected to form a floating surface slick that slowly dissolves in water. Its flash point of 50°F indicates that it can be easily ignited under a wide range of ambient temperature conditions. Vapors are slightly heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapors in confined spaces such as sewers or buildings may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 7.9 pounds per gallon.

Methyl methacrylate does not react with water or many other common materials and is stable in normal transportation, particularly when inhibited to prevent potentially violent self-polymerization. Such polymerization may occur, however, if the product is exposed to heat, oxidizing agents or ultraviolet light, and the product is reactive with various other chemicals. It is an irritant to bodily tissues and may be toxic if inhaled in high concentrations in air. Products of combustion may include carbon monoxide and acid fumes as well as other substances.

Downwind evacuation should be considered on a case by case basis if methyl methacrylate is leaking but not on fire. If a fire becomes uncontrollable ora container is exposed to direct flame, evacuate for a radius of one-half ($^{1}/_{2}$)mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 1.5 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, and ether.
Specific Gravity (liquid): 0.945 at 68°F (20°C)
Boiling Point: 214°F (101°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –54°F (–48°C)
Molecular Weight: 100.12
Heat of combustion: –6310 cal/g
Vapor Pressure: 35 mm Hg (0.677 psia) at 68°F (20°C)
Flash Point: 50°F (10°C), open cup
Autoignition Temperature: 790–815°F (421–35°C)
Burning Rate: 2.5 mm/minute
Stability: Stable
Corrosiveness: Noncorrosive to steel, aluminum, or stainless steel.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with nitrates, oxidizing materials (including peroxides and other initiators of polymerization), strong alkalis, strong acids, and reducing agents.

IDENTIFICATION

Shipping Names: Methyl methacrylate monomer, stabilized (USDOT & IMO)
Synonyms and tradenames: 2-propenoic acid, 2-methyl-, methyl ester; methacrylic acid, methyl ester; methyl-alpha-methylacrylate; methyl2-methyl-2-propenoate; acrylic resin monomer; 2-methylpropenoic acid;alpha-methyl acrylic acid.
Chemical formula: $CH_2 = C(CH_3)COOCH_3$
Constituent Components(% each): 99.8% Or more pure with trace (22-120 ppm) of polymerization inhibitor.
UN/NA Designation: UN1247
IMO Designation: 3.2, flammable liquid
Physical State as Shipped: liquid
Physical State as Released: liquid
Color of the Shipped Material: colorless
Odor Characteristics: Sharp, fragrant, pleasant, pungent, acrid, and fruity.
Common uses: Mfg. Plastics and resins used in a wide variety of products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

METHYL METHACRYLATE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.19–0.21 ppm

Unusual Hazards: Somewhat volatile flammable liquid with slightly heavier than air vapors that may travel to a source of ignition and flash back. Heat,chemical contaminants, or ultraviolet light may initiate self-polymerization with violent rupture of containers. Vapors are uninhibited and may form polymers in vents or flame arrestors, resulting in blockage.

Short Term Exposure Limits(STEL): 125 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 100 ppm over each 8 hours of a 40 hour work week.(ACGIH) conditions to avoid: heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in the spill area and immediately downwind. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with liquid methyl methacrylate may cause a skin rash, irritation, inflammation, and/or allergic skin reaction. Contact with the eyes may cause irritation requiring several days for recovery. One source suggests the possibility of corneal damage.

Hazards of Inhalation: Vapors of methyl methacrylate are irritating to the eyes, nose, throat, and respiratory system. High concentrations in air may cause narcosis with symptoms including drowsiness, headache, nausea, vomiting,and possibly unconsciousness. Exposure to 13,500 ppm in air for 3 hours was fatal to rabbits in laboratory experiments.

Hazards of Ingestion: Ingestion may result in irritation of the mouth, esophagus, and gastrointestinal tract as well as symptoms of narcosis.

FIRE HAZARD

Slower Flammable Limit: 2.1%

Upper Flammable Limit: 12.5%

Behavior in Fire: Flammable liquid. May generate significant quantities of flammable vapor upon release. Vapors are slightly heavier than air and may travel to a source of ignition and flash back. Exposure of containers to fire may result in polymerization and violent container rupture.

Hazardous Combustion Products: Include carbon monoxide, acid fumes, unburned methyl methacrylate, and other substances.

EXPLOSION HAZARD

Slower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat or light may cause spontaneous polymerization resulting in violent container rupture. Violent polymerization may also occur in the presence of oxidizing materials or ultraviolet light.

PROTECTIVE CLOTHING AND EQUIPMENT

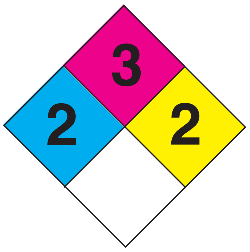
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, neoprene, polyethylene, polyurethane, and polyvinyl alcohol.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 4000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (4000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1247

METHYL METHACRYLATE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, skin, or respiratory tract; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution:administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff.Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of methyl methacrylate may result in damage, rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that methyl methacrylate is a somewhat volatile flammable liquid that may violently self-polymerize under conditions described in the general information section.

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Methyl methacrylate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION ... Methyl methacrylate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of methyl methacrylate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

METHYL METHACRYLATE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to methyl methacrylate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount of methyl methacrylate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and over fill impoundments.

TECHNIQUE

FOAM ... Firefighting foam applied to the surface of liquid pools may slow the release of methyl methacrylate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Methyl methacrylate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained methyl methacrylate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ... Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, peat moss, saw dust, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

METHYL METHACRYLATE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and any remaining chemical residue maybe removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCES

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS ... Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS ... Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Up stream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION ... Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

METHYL METHACRYLATE
Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING ... Oil spill skimming devices may be deployed to recover floating methyl methacrylate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION ... Straw, hay, peat, or commercial sorbent materials compatible with methyl methacrylate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause over flow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION ... Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION ... Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

METHYL ORTHOSILICATE

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Methyl orthosilicate is a colorless liquid that solidifies at 24.8ºF. It is highly toxic by inhalation. Although the volume of the product used in commerce is limited, some amounts are used in making TV picture tubes, mold binders, coatings, paints, lacquers, and other chemicals. Unfortunately, however, limitations on use mean that the available information on the properties and hazards of methyl orthosilicate is also limited and contains inconsistencies. It is unclear, for example, whether the product is insoluble in water as claimed by one authority or easily hydrolyzed (i.e., it decomposes or reacts) as claimed by others. Its flash point of 69ºF indicates the product may be easily ignited at moderate to high ambient temperatures. Vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.6 pounds per gallon, which is only very slightly heavier than water.

Compounds related to methyl orthosilicate are known to be thermally stable in transportation. Information on water reactivity (if any), corrosivity, and reactivity with other chemicals is generally unavailable but it can be safely assumed the product is incompatible with strong oxidizing agents that may cause its ignition. The primary reason that the product is little used in industry is that the liquid and its vapors pose considerable danger to the eyes and have an insidious delayed effect. In addition, it is of moderate to high toxicity by other routes of exposure. Products of combustion are not defined but likely to be irritating and/or poisonous.

Downwind evacuation should be considered if methyl orthosilicate is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Considered insoluble by one authority and soluble by another but there is a possibility it reacts; see below.

Solubility in Other Chemicals: Soluble in alcohol and ether.

Specific Gravity (Liquid): 1.023 - 1.032 at 68ºF (20ºC)

Vapor Density: 5.25

Boiling Point: 249.8 - 251.6ºF (121 - 122ºC) at 1 atm.

Melting Point: 24.8ºF (-4ºC)

Freezing Point: See melting point

Molecular Weight: 152.22

Heat of Combustion: Unavailable

Evaporation Rate: Unavailable

Vapor Pressure: 12 mmHg (0.2319 psia) at 77ºF (25ºC); another source reports 3.35 psi at 68ºF (20ºC).

Flash Point: 69ºF (20.6ºC), closed cup

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Flammable Limits: Unavailable

Stability: Stable.

Polymerization Potential: Will not occur.

Corrosiveness: Unavailable

Reactivity with Water: May decompose on exposure to moist air or water. Readily hydrolized.

Reactivity and Incompatibility: Oxidizes with hexafluorides of rhenium, molybdenum and tungsten. Incompatible with oxidizing agents, acids and bases.

IDENTIFICATION

Shipping Name(s): Methyl orthosilicate (USDOT & IMO)

Synonyms and Tradenames: Methyl o-silicate; Methyl silicate; Tetramethoxysilane; Tetramethyl silicate; Tetramethyl orthosilicate; Tetramethyloxysilane; Silicic acid, Tetramethyl ester

CAS Registry No.: 681-84-5

Chemical Formula: $(CH_3O)_4SI$

Constituent Components (% each): Unavailable

UN/NA Designation: UN2606

IMO Designation: 6.1, Toxic Substances

RTECS Number: VV9800000

NFPA 704 Hazard Rating: 3(Health): 3(Flammability): 1(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Solid or liquid; pure product solidifies at 24.8ºF (-4ºC).

Color of the Shipped Material: Colorless

Odor Characteristics: Unavailable

Reportable Quantity: See appendix I.

Common Uses: Coating TV picture tubes; in mold binders and corrosion resistant coatings; silicone intermediate; in catalyst preparation; bonding agent in paints and lacquers. Little used in commerce at present.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

METHYL ORTHOSILICATE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic by inhalation and extremely hazardous to the eyes.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1 ppm

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazards are from inhalation or eye contact with the high vapor concentrations that may be present in air in the spill area and downwind. Ingestion and direct physical contact are also to be strictly avoided.

Hazards of Eye Contact: Both liquid methyl orthosilicate and its vapors are extremely hazardous to the eyes. Although immediate effects may be slight, a serious reaction may take place several hours after the exposure resulting in swelling of the lids and conjunctivae, pain, destruction and opacification of the cornea, and possibly permanent blindness. Exposure to even 1000 ppm of vapors in air for 15 minutes may require hospitalization.

Hazards of Skin Contact: Specific data on the effects of skin contact are unavailable but contact is expected to cause some type of injury.

Hazards of Inhalation: Excessive inhalation of methyl orthosilicate may result in pulmonary edema (which may be delayed in onset), kidney damage, and possibly severe consequences. Exposure to 160 ppm for 10 minutes was fatal to some mice in laboratory experiments while 250 ppm for four hours proved fatal to rats.

Hazards of Ingestion: Methyl orthosilicate is moderately toxic via ingestion. Effects may include pulmonary edema and injury to the kidneys.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquid. Containers may rupture violently in fire. May generate large quantities of flammable and toxic vapor upon release. Vapors may travel some distance to a source of ignition and flash back.

Hazardous Combustion Products: Toxic fumes of carbon monoxide, carbon dioxide, silicon oxide, hydrogen cyanide, oxides of nitrogen and methanol.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

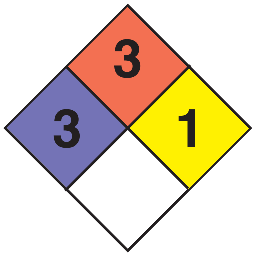
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, wear a self contained breathing apparatus (SCBA) with full facepiece.

2606

METHYL ORTHOSILICATE

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues. Highly destruction to skin, eyes, mucous membranes and upper respiratory tract. Ingestion or inhalation could prove fatal.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Information is limited. Get immediate medical advice and attention. One manufacturer suggests to administer large quantities of water and not to induce vomiting.

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Take the flammable and toxic nature of methyl orthosilicate into account when planning the response.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of fuel oil in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

METHYL ORTHOSILICATE

Division 6.1 (Poisonous Materials)

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited to spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to methyl orthosilicate vapors or fumes may accelerate their dispersal in the atmosphere. (Note: Apply water cautiously at first if liquid methyl orthosilicate is exposed. The reactivity of water with this product is not well defined.)

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of methyl orthosilicate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that application of an appropriate firefighting foam to the surface of liquid pools may slow the release of methyl orthosilicate vapors into the atmosphere. The fact that foam is recommended for firefighting suggests it may also have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Methyl orthosilicate may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined methyl orthosilicate may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

METHYL ORTHOSILICATE
Division 6.1 (Poisonous Materials)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product. Pure product may solidify and clog lines or pumps in cold weather.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Keep product warm if necessary.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

METHYL ORTHOSILICATE

Division 6.1 (Poisonous Materials)

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Insufficient data precludes the provision of more specific advice in this guide.

October 1993

METHYLTRICHLOROSILANE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Methyltrichlorosilane is a colorless, volatile, flammable, corrosive, and fuming liquid with an odor variably described as sharp, pungent, acrid, irritating and resembling hydrochloric acid. It can be easily ignited under most ambient temperature conditions. Its vapors and fumes are heavier than air, may persist in low areas, or travel some distance to a source of ignition and flash back. Accumulations in confined spaces such as buildings or sewers may explode if ignited. The liquid weighs about 10.6 pounds per gallon.

Although stable when in sealed containers, it reacts violently with water to form corrosive hydrochloric acid while generating heat, white acid fumes, and a mixture of methylsiloxanes which may or may not be heavier than water or soluble therein. It also generates acid fumes when exposed to moist or humid air. It is otherwise reactive with a broad range of materials. Both the liquid and its vapors and fumes are highly corrosive to bodily tissues by all routes of exposure. Products of combustion are not well defined but are variably reported to include corrosive hydrogen chloride and hydrochloric acid, extremely toxic phosgene, carbon monoxide, carbon dioxide, silicon oxide, highly dispersed silica, and other irritant and toxic substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if methyltrichlorosilahe is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts violently.
Solubility in Other Chemicals: Soluble in toluene.
Specific Gravity (Liquid): 1.270 - 1.273 at 77°F (25°C).
Boiling Point: 150.8 - 152°F (66 - 66.7°C) at 1 atm.
Melting Point: - 130°F (- 90°C) or - 108°F (- 77.8°C); reported values vary.
Freezing Point: See melting point.
Molecular Weight: 149.5.
Heat of Combustion: - 1,700 cal/g.
Vapor Pressure: 40 mm Hg (0.7732 psia) at 19.4°F (- 7°C); 132 mm Hg (2.551 psia) at 68°F (20°C).
Flash Point: Most say 15°F (- 9.4°C) closed-cup; 45°F (7.2°C), open-cup.
Autoignition Temperature: Greater than 760°F (404°C).
Burning Rate: 1.9 mm/minute.
Stability: Stable in sealed container.
Corrosiveness: Carbon steel is satisfactory for use with the dry product but any contact with water or moisture produces hydrochloric acid which is corrosive to most metals, and which will generate flammable and potentially explosive hydrogen gas.
Reactivity with Water: Reacts violently with water to form corrosive hydrochloric acid while generating heat, white acid fumes, and a mixture of methylsiloxanes. Methyltrichlorosilane will also generate acid fumes when exposed to moist or humid air.
Reactivity with Other Chemicals: Reported as incompatible and potentially capable of violent reactions producing hydrogen chloride with acids, bases (alkalis), oxidizing materials, and chemically active metals (such as potassium, sodium, magnesium, and zinc). Hydrogen gas evolved upon contact with a base may ignite spontaneously. Mixtures of very similar methyldichlorosilane with potassium permanganate, lead (II) oxide, lead (IV) oxide, copper oxide, or silver oxide form impact-sensitive explosive materials. It reacts violently with a broad range of other materials.

IDENTIFICATION

Shipping Names: Methyltrichlorosilane.
Synonyms and Tradenames: Methylsilicon trichloride; methylsilyl trichloride; methyl trichlorosilane; monomethyltrichlorosilane; trichloromethylsilane; and trichloromethylsilicon.
Chemical Formula: $\mathrm{CH3_3SiC1_3}$.
Constituent Components (% each): Apparently 95% or more pure with remainder consisting of 1 - 5% dimethyldichlorosilane and probably small quantities of similar substances.
UN/NA Designation: UN1250.
IMO Designation: 3, flammable.
Physical State As Shipped: Liquid.
Physical State As Released: Fuming liquid.
Color of the Shipped Material: Colorless.
Odor Characteristics: Sharp, pungent, acrid, irritating, resembling hydrochloric acid.
Common Uses: Used to make silicones for water repellants, electrical insulation, heat resistant paints, and other products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

METHYLTRICHLOROSILANE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available for methyltrichlorosilane; reported as 10 ppm in air for the similar methyldichlorosilane.

Unusual Hazards: Highly reactive fuming liquid. Reacts violently with water. Spraying water on the source of any leak may potentially cause corrosion due to formation of hydrochloric acid and increase the leakage area.

Short Term Exposure Limit (STEL): Not established by recognized authority.

Time Weighted Average (TWA) Limit: Not established by recognized authority.

Ceiling (C) Limit: Not established for methyltrichlorosilane. For hydrogen chloride, the absolute ceiling limit is 5 ppm (ACGIH, 1992 -93; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; contact with water or moisture; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Methyltrichlorosilane is highly corrosive to bodily tissues by all routes of exposure. Dangerous concentrations of its vapors and fumes may be present in the spill area and over considerable downwind distances.

Hazards of Skin or Eye Contact: Liquid methyltrichlorosilane may rapidly cause severe burns and tissue destruction upon contact with the skin or eyes, with eye effects including inflammation, pain, swelling, erosion of the cornea, severe damage to the cornea and lids, and possibly permanent injury and/or loss of sight. Effects on the skin may additionally include inflammation, pain, shock, and a risk of secondary infections. Exposure to concentrated vapors or fumes in air may also cause significant eye and skin irritation and also has the potential to result in eye damage. Contact lenses should not be worn when working with this material.

Hazards of Inhalation: Vapors and fumes of methyltrichlorosilane are highly irritating and corrosive to the nose, mouth, throat, respiratory tract, and lungs. Excessive exposures may result in such symptoms as a burning sensation, immediate distress, coughing, wheezing, hoarseness, laryngitis, shortness of breath, a choking sensation, headache, nausea, vomiting, spasms, bleeding of the nose and gums, possible ulceration of nasal and oral mucosa, inflammation and edema of the larynx and bronchi, possible kidney damage, loss of consciousness, pulmonary edema (which may be delayed in onset), chemical pneumonitis, and possibly death. Exposure to 450 ppm of methyltrichlorosilane in air for 4 hours or 1,550 ppm for 1 hour was sufficient to kill 50% of rats in laboratory experiments. It has been crudely estimated that exposure to 2,000 ppm of methyltrichlorosilane for 10 minutes (and possibly less) may be lethal to some humans. More conservative estimates are that concentrations of 1,300 to 2,000 ppm of hydrogen chloride in air may be lethal within a few moments. The saturated vapor concentration over a pool of liquid methyltrichlorosilane is about 52,630 ppm at 19.4°F (-7°C); 131,580 ppm at 53.8°F (12.1°C); and 173,685 ppm at 68°F (20°C).

Hazards of Ingestion: Ingestion of methyltrichlorosilane will cause severe burns of the mouth, throat, and stomach and may prove fatal. Symptoms of excessive single oral doses are additionally reported to include salivation, intense thirst, difficulty in swallowing, chills, pain, and shock. Any vomit generally has the appearance of coffee grounds. The potential for circulatory collapse is high. The lowest single oral dose reported to cause deaths among rats in laboratory experiments is 800 mg of methyltrichlorosilane per kilogram of an animal's body weight according to one source.

FIRE HAZARDS

Lower Flammable Limit: 7.2 to 7.6%.

Upper Flammable Limit: Variably reported as 11.9% to 20%.

Behavior in Fire: Flammable liquid. Difficult to extinguish and prone to reignition. May generate large quantities of flammable and corrosive vapors and fumes upon release. Vapors may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in a fire and possibly rocket.

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in a fire and possibly rocket. Reaction with water or moisture produces hydrochloric acid which may evolve potentially explosive hydrogen gas in contact with most metals. Mixtures with certain other chemicals may result in an explosion or formation of explosive compounds. There is a possibility that entry of water into a closed container of methyltrichlorosilane may result in its rupture if sufficiently high gas and vapor pressures are generated.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and/or gas-tight safety goggles, and other impervious and resistant clothing as appropriate. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary for fire fighting and wherever high vapor or fume concentrations may be encountered in

PROTECTIVE CLOTHING AND EQUIPMENT *(CONTINUED)*

air. Based on limited data, one authority indicates that Viton and polyethylene/ethylene vinyl alcohol/polyethylene (PE/EVAL/PE) materials may be compatible with methyltrichlorosilane. Compatible materials for various strengths of hydrochloric acid may include butyl rubber, natural rubber, neoprene, nitrile rubber, PE/EVAL, polyvinyl chloride (PVC), Viton, and Saranex according to various authorities. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting, spasms, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If conscious, have victim wash out mouth with large amounts of water which should not be swallowed; then slowly administer 1 or 2 glasses of water or milk to an adult, proportionately less to a child. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Authorities disagree substantially on which agents to apply. NFPA 49 recommends dry chemical, carbon dioxide, foam, or water spray while noting that water may be ineffective. The U.S. DOT (in ERG90) agrees with the NFPA for small fires but suggests use of water spray, fog, or regular foam on large fires. A major maker of the product warns that water should not be used because of the violent reaction that may take place but considers the use of foam acceptable. A Coast Guard publication warns not to use either water or foam because of the reaction problem. Everyone agrees that no water should be permitted to enter containers. Overall, it appears most prudent to avoid use of water or foam if the fire is small unless the burning liquid can rapidly and truly be flooded with comparatively massive amounts. For large fires which cannot reasonably be permitted to burn themselves out, use extreme caution and apply water in very large quantities as a spray or fog or apply large amounts of foam from a protected location or from as far a distance as possible. Use professional judgment as necessary to select from or modify these recommendations.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with products of combustion or vapors/fumes of methyltrichlorosilane is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire. Do not apply water or foam to leakage area of methyltrichlorosilane containers or permit either to enter such containers if possible.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away fromspill area. Avoid contact with spilled product or its vapors or fumes. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use. Handle and store this material under dry nitrogen if possible. Take all the reactivity, corrosivity, toxicity, volatility, and flammability hazards of methyltrichlorosilane into account when planning the response.

METHYLTRICHLOROSILANE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION. . . Evacuate local and downwind areas as conditions warrant to prevent exposure and allow vapors or fumes to dissipate. Methyltrichlorosilane spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors and fumes in air may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid methyltrichlorosilane as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain varying amounts of hydrochloric acid and other chemicals from contact with vapors and fumes.

MITIGATION

Contain contaminated water and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FLOODING WITH WATER . . . The rapid addition of flooding quantities of water to pools of liquid methyltrichlorosilane may eventually slow the release of vapors and fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor and fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. The reaction between water and methyltrichlorosilane may be violent.

MITIGATION

Some possibilities include knockdown of vapors and fumes via large amounts of water fog and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts. Contain resulting liquids and neutralize and/or remove them as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that alcohol or regular foam applied to the surface of liquid pools may slow the release of vapors and fumes into the atmosphere. (Note: Several authorities suggest foam use for firefighting even though the water in the foam will clearly react with the spilled product. Thus, foam may possibly control vapor and fume evolution if a blanket can be maintained over liquid pools.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. There may be at least an initial increase in vapor and fume evolution when the foam is first applied.

MITIGATION

Proceed with caution. Stand ready to control increases in vapor or fume evolution with water spray or fog applied at a point downwind and/or temporarily evacuate downwind populations and other vulnerable resources. Abandon the effort if vapor and fume evolution does not decrease after a reasonable amount of foam has been applied. If the method works, continue foam application until the spilled product is removed or otherwise treated. Contain increased volume of liquids.

TECHNIQUE

NEUTRALIZATION . . . There is a possibility that application of an appropriate neutralization agent to liquid methyltrichlorosilane may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing methods.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid methyltrichlorosilane, its reaction products with water, or contaminated water runoff may be contained by building dikes or barriers using dry sand, soil, or other compatible materials.

METHYLTRICHLOROSILANE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained substances and spread of contamination.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquids.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Neutralize and/or remove contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the liquid may become damaged or develop leaks. High pressures may rapidly develop in equipment if water or moisture is present and liquid methyltrichlorosilane is to be recovered.

MITIGATION

Use compatible equipment that has adequate pressure capacity and/or which is free of moisture.

TECHNIQUE

ABSORPTION . . . Spreading of liquids may be controlled by absorbing them with dry sand, earth, clay, lime, soda ash, vermiculite, commercial sorbents, or other compatible substances as appropriate and available according to various authorities.

CONSEQUENCE

Once used, most sorbent materials pose the same hazards as the absorbed liquid. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product or other contained liquids to less hazardous substances.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and/or chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product and any hydrochloric acid that may be present. Do not operate motorized equipment in potentially flammable atmospheres (including those caused by evolution of hydrogen gas due to corrosion of metals by hydrochloric acid). Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Methyltrichlorosilane reacts violently with water to produce corrosive hydrochloric acid, potentially large quantities of acid fumes, and a mixture of methylsiloxanes that are not generally soluble

METHYLTRICHLOROSILANE
Class 3 (Flammable Liquid)

WATER SPILL *(CONTINUED)*

in water (though some might be to some extent) and which may or may not be heavier. Specific data on the nature, properties, and hazards of these methylsiloxanes were not available, so only general guidance can be provided about containment and recovery methods that may be appropriate. Contact shippers or other sources of expert advice for assistance.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce the environmental hazards of hydrochloric acid.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

CONTAINMENT . . . Some methylsiloxanes are likely to sink in water and not dissolve therein. Where necessary, use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Where deemed necessary and appropriate, stream or lake beds may be dredged to remove heavier-than-water methylsiloxanes and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. There may be other hazards associated with methylsiloxanes.

MITIGATION

Consult qualified experts for guidance.

March 1995

MOTOR FUEL ANTIKNOCK COMPOUND
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Motor fuel antiknock compounds considered here are variable mixtures of tetramethyl lead, tetraethyl lead, ethylene dibromide, ethylene dichloride, toluene, and other solvents or dyes. They have a sweet, musty and fruity odor and are used to increase the octane of gasoline. The mixtures are barely soluble in water and heavier, so may be expected to sink and dissolve at a slow rate. Depending on the specific mixture, flash points may vary from 30-264°F. Those mixtures with lower flash points may be ignited under a wide range of ambient temperature conditions. Their vapors may travel to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Regardless of the specific mixture involved, containers may rupture or explode if exposed to fire or excessive heat for sufficient time duration. The mixtures weigh approximately 12.5-14.2 pounds per gallon. Reportable quantities range from 100 lb (45.4 kg) for tetraethyl lead to 5000 lb (2270 kg) for ethylene dichloride.

Motor fuel antiknock compounds do not react with water but do react with oxidizing materials, active metals and rust, and concentrated acids. Temperatures above 212°F may initiate a self-sustaining decomposition that may lead to an explosion of containers if the hot compound is ignited by a flame or hot metal surface. The presence of ethylene dibromide in a specific mixture may, however, render it stable at temperatures as high as 300°F for 15 hours. All mixtures should be considered highly toxic and all exposures should be avoided. Products of combustion are also toxic and may include gases containing lead as well as several other toxic or irritating substances.

Downwind evacuation should be considered if motor fuel antiknock compound is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: 28-55 ppm at 60°F (15.6°C)
Solubility in Other Chemicals: Soluble in alcohol, benzene, ether, and petroleum ether.
Specific Gravity (Liquid): 1.5-1.7
Boiling Point: 200-300°F (93.3-148.9°C) at 1 atm; may decompose and explode
Melting Point: – 63.4 to 15.8°F (– 53 to – 9°C)
Freezing Point: – 63.4 to 15.8°F (– 53 to – 9°C)
Molecular Weight: Unavailable (mixture)
Heat of Combustion: –10100 cal/g (est.)
Vapor Pressure: 5.2-35.7 mm Hg (0.101-0.690 psia) at 68°F (20°C)
Flash Point: 30-228°F (–1.1 to 109°C) or more, closed cup; 89-265°F (31.7-129.4°C), open cup.
Autoignition Temperature: Begins to decompose above 212°F (100°C).
Burning Rate: Unavailable
Stability: Decomposes above 212°F (100°C) or 300°F (149°C) if ethylene dibromide present; may explode under such conditions.
Corrosiveness: Lead allyls may attack some forms of plastics, rubber, and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with oxidizing materials, active metals and rust, and concentrated acids.

IDENTIFICATION

Shipping Names: Motor fuel anti-knock compound (USDOT); antiknock compound (USDOT); motor fuel anti-knock mixtures (IMO).
Synonyms and Tradenames: Antiknock compound
Chemical Formula: Mixture
Constituent Components(% each): 50-60% lead allyls; 18-36% ethylene dibromide; 0-19% ethylene dichloride; 2-12% toluene, other solvents, and dyes.
UN/NA Designation: UN1649
IMO Designation: 6.1, poisonous substance
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Red, orange, or blue (dyed)
Odor Characteristics: Sweet, musty, fruity
Common Uses: Gasoline antiknock additive

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

MOTOR FUEL ANTIKNOCK COMPOUND

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic combustible or flammable liquid. Containers may explode or detonate if product is heated to decomposition.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 0.1-0.15 mg/m^3 (as lead) over each 8 hours of a 40 hour work week for lead alkyls.(ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Motor fuel antiknock compounds are highly toxic via all routes of exposure including skin absorption. Lead compounds may accumulate in the bodies of humans and animals.

Hazards of Skin or Eye Contact: Motor fuel antiknock compounds may be absorbed through the skin in toxic amounts. Eye contact may cause irritation and possibily other effects.

Hazards of Inhalation: Excessive exposure to motor fuel antiknock compounds may cause insomnia, anxiety, tiredness, paleness, nausea, loss of appetite, trembling, excitability, delirium, convulsive seizures, coma, and possibly death. Symptoms may be delayed in onset for up to eight days.

Hazards of Ingestion: See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable or combustible liquid. May generate significant quantities of flammable and toxic vapors upon release. Vapors of some mixtures may be heavier than air and may travel to a source of ignition and flash back. Containers may explode or rupture violently in fire.

Hazardous Combustion Products: Toxic; may include carbon monoxide, and gases containing lead, chlorides, bromides, and other hazardous substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may explode or rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact and any possibility of skin contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific symptoms: See hazards of inhalation above.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Adminstration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with kerosene or similiar product followed by copious amounts of soap and water. Get medical attention immediately.

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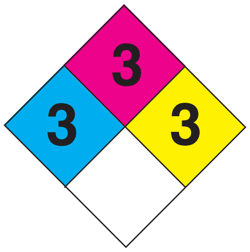
MOTOR FUEL ANTIKNOCK COMPOUND

Division 6.1 (Poisonous Material)



FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray.

Extinguishing Techniques: Unusual toxicity and explosion hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the toxicity and properties of motor fuel antiknock compounds into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Motor fuel antiknock compound spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to motor fuel antiknock compound vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount of motor fuel antiknock compound from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of motor fuel antiknock compound vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

MOTOR FUEL ANTIKNOCK COMPOUND

Division 6.1 (Poisonous Material)

TECHNIQUE

COVERAGE . . . The application of water spray to the surface of contained liquid pools may slow the release of vapors into the atmosphere. Water should float on top of the spilled product.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Motor fuel antiknock compound may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained motor fuel antiknock compound may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

MOTOR FUEL ANTIKNOCK COMPOUND
Division 6.1 (Poisonous Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

MOTOR FUEL ANTIKNOCK COMPOUND

Division 6.1 (Poisonous Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 1992

NAPHTHALENE
Division 4.1 (Flammable Solid)

GENERAL INFORMATION

Naphthalene is a colorless to white to brownish solid that may be shipped in the form of powders, scales, prismatic plates, crystalline flakes, balls, or cakes. It may also be shipped as a hot molten liquid at a temperature above the melting point of the material or in solution with another liquid. Naphthalene is best known as the primary ingredient of moth balls and has the characteristic odor of this substance. The product has numerous other uses in industry, is practically insoluble in water, and with some exceptions, is expected to sink in water.

Naphthalene has a flash point in the range of 174 –190°F (79 – 88°C) and is therefore classified as a flammable solid. The solid form will usually be difficult to ignite unless preheated or in the form of a powder or dust, the latter of which has been known to explode if ignited when dispersed in air (presumably when confined to some degree). Since the melting point temperatures of solid grades of naphthalene range from 165 – 177.8°F (74 – 81°C), any hot molten naphthalene being transported or stored may be fairly easily ignited upon release until such time as it cools. Direct application of firefighting foam or water spray onto molten naphthalene may result in potentially violent or explosive foaming and spattering if the liquid is very hot. The solid product weighs in the range of 71.45 – 72.51 pounds per cubic foot. The molten liquid weighs about 8.03 pounds per gallon at a temperature of 212°F (100°C).

Naphthalene does not actually react with water or many other common materials and is primarily known to be incompatible with strong oxidizing materials that may cause a violent reaction or its ignition or explosion under appropriate conditions. It is not corrosive to common metals but molten naphthalene may possibly attack some forms of plastics, rubber, and coatings.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.0030–0.0034 g/100 g water in the temperature range of 68 – 77°F (20–25°C).

Solubility in Other Chemicals: Very soluble in benzene, carbon tetrachloride, carbon disulfide, chloroform, ether, hydronaphthalenes, and fixed and volatile oils. Soluble to varying degrees in acetone, alcohols, other aromatic solvents, chlorinated hydrocarbons, olive oil, and turpentine.

Specific Gravity: 1.145–1.162 at 68°F (20°C) for relatively pure solid; 0.963 at 212°F (100°C) for hot molten liquid.

Boiling Point: 424 –424.4°F (217.8 –218°C) at 1 atm for pure substance.

Melting Point: 176–177.8°F (80–81°C) for relatively pure product; 165 –177.8°F (74 – 81°C) is the overall range reported for crude to pure grades.

Freezing Point: See melting point

Molecular Weight: 128.17

Heat of Combustion: –9287 cal/g

Vapor Pressure: 0.05 – 0.054 mm Hg (0.00097 –0.00104 psia) at 68°F (20°C); 1 mm Hg (0.01933 psia) at 127°F (52.6°C); 10 mm Hg (0.1933 psia) at 186°F (85.6°C).

Flash Point: Reported closed and open-cup temperatures range from 174–190°F (79–88°C).

Autoignition Temperature: Reported values range from 979–1089°F (526–587°C).

Burning Rate: 4.3 mm/minute

Stability: Stable

Corrosiveness: Not reported as corrosive to common metals. Molten naphthalene may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: Molten naphthalene spatters and foams in contact with water or firefighting foams according to one authority. Another reports that the foaming may be violent if the naphthalene is at a temperature at or above 230'F (110'C). Naphthalene does not actually chemically react with water.

Reactivity with Other Chemicals: Contact with strong oxidizers may result in violent reaction, ignition or explosion. For compatibility classification purposes, naphthalene is considered to be in the family of phenols and cresols. Such materials typically generate heat in reactions with non-oxidizing mineral acids or organic peroxides or hydroperoxides.

IDENTIFICATION

Shipping Names: Naphthalene, crude; naphthalene, refined; naphthalene, molten.

Synonyms and Tradenames: Camphor tar; moth balls; moth flakes; naphthalin; naphthaline; naphthene; NTM; tar camphor; white tar.

Chemical Formula: $C_{10}H_8$ (as two fused benzene rings)

Constituent Components (% each): Naphthalene derived from coal tar contains about 90–95% naphthalene. Naphthalene is graded according to its melting point according to another authority; crude forms have a minimum melting point of 165°F (74°C) while refined grades have melting points of 174°F (79°C) or greater.

49 STCC: 49 403 60 (crude); 49 403 61 (other than crude); 49 174 59 naphthalane, molten.

UN/NA Designation: UN1334 (crude or refined); UN2304 (molten)

IMO Designation: 4.1, flammable solid

Physical State As Shipped: Hot liquid when molten at temperatures above the melting point of naphthalene. Various forms of solids such as scales, powders, prismatic plates, crystalline flakes, round balls, or cakes at lower temperatures.

Physical State As Released: Same as shipped; molten liquid will solidify as it cools down.

Color of the Shipped Material: Normally colorless or white; some grades may be brownish in color.

Odor Characteristics: Like mothballs or coal tar

Common Uses: Used or found in the production of antiseptics, cable coatings, celluloid, coatings, detergents, dyes, emulsion breakers, fungicides, insecticides, lampblack, lubricants, and moth repellants.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

NAPHTHALENE
Division 4.1 (Flammable Solid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: The lowest odor threshold found in the literature was 0.003 ppm in air but most reference sources report a range of 0.3 to 0.9 ppm as being detectable by humans. The characteristic odor of mothballs is said to be recognizable at about 25 ppm in air.

Unusual Hazards: Certain population groups are far more sensitive to the effects of naphthalene exposure than others. Very hot molten naphthalene may foam and spatter, possibly violently or explosively, upon contact with water or firefighting foam steam generation in tanks could be violent and cause tank rupture or personnel burns. By analogy to other substances, there is a possibility that pressure relief devices (if any) on tanks of the molten liquid may be susceptible to plugging with solid and subsequent malfunction. Moreover, naphthalene may remain molten under a solid crust for extended periods; check carefully before walking on such crusts.

Short Term Exposure Limit (STEL): 15 ppm (75 mg/m^3) for 15 minutes (ACGIH, 1991–92; OSHA, 1989).

Time Weighted Average (TWA) Limit: 10 ppm (50 mg/m^3) over each 8 hours of a 40 hour work week (ACGIH, 1991 –92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry to sewers or water bodies; generation of dust clouds; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate vicinity and directly downwind of a spill, particularly and especially if molten naphthalene has been discharged.

Hazards of Skin or Eye Contact: Hot molten naphthalene may cause severe burns upon contact with the skin or eyes. Otherwise contact of naphthalene with the eyes in spill situations is irritating but not injurious unless actual particles are allowed to remain in contact with the cornea, in which case temporary superficial corneal injury, inflammation, and localized diminished visual acuity lasting as long as two weeks (according to experiments with rabbits) may be experienced. Vapors of naphthalene are reported as distinctly irritating to the eyes at levels above 15 ppm in air. Do not wear contact lenses when working with this chemical. Prolonged or repeated skin contact may cause itching, redness, swelling, scaling and/or crusting and, in some cases, an allergic rash. Massive and/or prolonged exposure of the skin to naphthalene may also result in absorption through the skin which is facilitated by the presence of oils, and which may cause a number of the effects associated with inhalation and ingestion.

Hazards of Inhalation: Poisoning from exposures in the normal working environment is rare according to one authority. Another reports that concentrations above 10 ppm can eventually cause headache, vomiting, nausea, and profuse sweating. Prolonged or excessive exposures to high levels of dust, fumes or vapors in air are additionally reported to potentially cause coughing, mental confusion, irritation of the nose and throat, abdominal cramps, inflammation of the optic nerve, cataracts and possibly other severe eye effects destruction of red blood cells leading to anemia, fever and yellow jaundice, kidney and liver damage, painful urination, bloody or dark urine, tiredness, diarrhea, convulsions, coma, and possibly death. Increased susceptibility to poisoning has been reported among persons with the inherited metabolic deficiency discussed above. Indeed, exposure to concentrations as low as 10 ppm (for unspecified time periods, but presumably fairly prolonged ones) may produce adverse blood changes in some such hypersusceptible individuals. In any case, some of the effects reported above may not appear for 2–4 hours after exposure and others may be considerably further delayed in onset. There is limited evidence that excessive exposure to naphthalene may damage the developing fetus in pregnant women. At 68°F (20°C), the saturated vapor concentration of naphthalene in air just over the spilled material is in the range of 66 to 71 ppm. It is about 1315 ppmat 126.7°F (52.6°C) and about 13,160 ppm at 186.4°F (85.8°C). Any airborne naphthalene dust in air will add to vapor exposures.

Hazards of Ingestion: The effects of ingesting naphthalene are generally similar to those associated with excessive inhalation. Although the oral toxicity of the substance is considered low, the lowest published lethal dose for a human child by ingestion is just 100 mg of naphthalene per kilogram of body weight. Larger doses are apparently necessary to prove lethal to human adults and animals, with considerable variability shown among species.

FIRE HAZARDS

Lower Flammable Limit: *0.9%*

Upper Flammable Limit: *5.90*

Behavior in Fire: Combustible solid product may require preheating prior to ignition but powdered form or dust in air may be more easily ignited. Molten product is likely to be flammable upon release and easily ignited. Direct application of foam or water spray onto molten naphthalene may result in extensive foaming and possible spattering which may possibly be violent and even somewhat explosive if the molten liquid is very hot.

Hazardous Combustion Products: Not well-defined burning naphthalene is reported to produce dense acrid smoke, irritating fumes, carbon dioxide, carbon dioxide, and possibly other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from the hot molten liquid are ignited in a confined area. Contact with certain other chemicals may result in an explosion. Naphthalene dust may explode if dispersed in air and ignited, particularly in a confined area.

1334

NAPHTHALENE
Division 4.1 (Flammable Solid)

See UN/NA Designation for
other ID numbers.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with hot molten naphthalene. For "cool" solids, equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, dust-or splash-proof safety goggles as appropriate, and other impervious and resistant clothing. Compatible materials for non-molten naphthalene may include Teflon according to one authority. Another authority, which treats the product as an aromatic hydrocarbon and not the closely related polynuclear hydrocarbon it actually is, suggests that Viton, chlorinated polyethylene, and Viton/neoprene may be compatible materials. Be advised that handling of hot molten naphthalene may require clothing that provides protection against high temperatures. Handling of "cool" solid naphthalene for relatively short periods of time may possibly be accomplished using any of a wide variety of clothing or glove materials.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations (500 ppm or less), a gas mask with chin-style or front or back mounted organic vapor canister and dust filter or a chemical cartridge respirator for organic vapors with a dust filter and a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific symptoms: Irritation of the skin or eyes; headache, nausea, profuse sweating, vomiting, coughing, irritation of the nose and throat, mental confusion, and diarrhea, among others.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention if irritation persists after washing or if burns have occurred. If molten naphthalene contacts the skin, immediately flush the skin with large amounts of water, remove contaminated clothing, and get medical attention immediately. Note that removal of solidified molten material from the skin may require qualified medical assistance. In other cases, promptly wash affected skin with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Seek qualified medical advice as soon as possible on the question as to whether vomiting should be induced since various authorities disagree on this issue. A 1981 NIOSH guide recommends that large quantities of water be administered if the victim is conscious, that vomiting be induced, and that immediate medical attention be obtained. More recent publications essentially say: Have conscious victim rinse mouth thoroughly with water and then drink glass of water. Do not induce vomiting. If vomiting occurs naturally, have victim rinse mouth and repeat administration of water. In either case, never make an unconscious person vomit. If vomiting is induced or occurs naturally, have the victim lean forward with head below hips to reduce the risk of aspiration into the lungs. Get qualified medical attention as soon as possible. (Note: There "appear" to be some valid reasons in the literature that support the recommendation that vomiting not be induced if relatively prompt medical attention is available, except possibly in cases where fats have been ingested together with the naphthalene or the victim is a small child.)

FIRE RESPONSE

Extinguishing Materials: Sand or earth can be used on small fires. Also, water spray, carbon dioxide, dry chemical, or foam. Authorities disagree on whether regular or alcohol foam should be used; both are probably effective to some degree. Solid streams of water may be ineffective. Note that application of foam or a direct water spray may potentially cause extensive and possibly violent or somewhat explosive foaming if applied to very hot molten naphthalene but are nevertheless recommended for use by most authorities. Apply these agents with caution at first.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be advised that introduction of water into a tank of molten naphthalene may possibly result in frothing, boilover, and/or violent steam generation. By analogy to other substances, do not depend on pressure relief devices to limit pressure in tank of molten liquid; these may possibly become plugged with solid.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers or confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Keep the unusual toxicological characteristics of naphthalene in mind when planning the response. Use professional judgment with respect to which precautionary measures listed above and others are most suitable for a given situation. Give special attention to whether the naphthalene is molten or one of several possible forms of solid since hazards will vary in severity and type depending on the answer to this question. Be advised that there is a possibility that the discharge of a carbon dioxide fire

SPILL RESPONSES (continued)

General Information (continued): extinguisher at the point of leakage of hot molten naphthalene has the potential to solidify the naphthalene and stop the leak in some cases, at least temporarily. Other means of attempting to solidify the leaking naphthalene via cooling may also work. Whether or not the "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the container and its temperature. It may become necessary to repeat the procedure several times until the leak can be patched or to ultimately abandon the effort. Again, use professional judgment in attempting this type of response action.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Naphthalene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations, especially if it is discharged as a "cool" non-dusty solid. It may be advisable in such cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of naphthalene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and dusts to dissipate. Naphthalene discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases, particularly if hot molten naphthalene has spilled or large amounts of dust somehow become airborne.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary. Note that the vapor pressure of the molten product and its vapor emission rate will decrease as it solidifies and cools in the ambient environment or if various means (see below) are used to accelerate its rate of cooling.

TECHNIQUE

PROTECTION FROM WIND . . . Where necessary, cover solid naphthalene with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to naphthalene vapors or fumes in air may accelerate their dispersal in the atmosphere. Similarly, this response may knockdown any dust in air. Cooling of spills of molten naphthalene with water spray will solidify and cool the product, thus reducing its temperature and vapor emission rate. Maintenance of a layer of water on top of a contained pool of molten naphthalene that has solidified on its surface may greatly reduce vapor emissions. A fine water fog used to wet the surface of exposed powdered naphthalene may reduce generation of airborne dust.

CONSEQUENCE

Water runoff may contain varying amounts of naphthalene. As discussed earlier, contact of hot molten naphthalene with a direct water spray may result in potentially violent foaming and spattering of the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Apply water spray with caution to hot molten naphthalene at first.

TECHNIQUE

FOAM . . . There is a possibility that alcohol or regular firefighting foam applied to the surface of contained liquid pools of hot molten naphthalene may slow the release of vapors into the atmosphere. (Note: The fact that both types of foam are recommended by various authorities for firefighting purposes suggests they may also have value in suppressing vapor evolution.)

TECHNIQUE (continued)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors may increase unless the products of breakdown form a layer of water over the solidified products. Products of foam breakdown will add to the volume of spilled material. As discussed earlier, contact of hot molten naphthalene with firefighting foam may result in potentially violent foaming and spattering of the product.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply foam with caution to hot molten naphthalene at first.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Naphthalene in most forms may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained naphthalene solutions or contaminated water used for cooling may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases depending on the form of the product and circumstances of the spill and response.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools of contaminated water or naphthalene solutions may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. This response is unlikely to be appropriate for molten naphthalene since cooling of the product may result in its solidification and subsequent plugging or clogging of transfer or storage equipment.

CONSEQUENCE

Equipment that is incompatible with the liquid being recovered may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the liquid being recovered.

TECHNIQUE

ABSORPTION . . . Spreading of contaminated water or naphthalene solutions may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil or spilled product or its residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or combustible dusts present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable or combustible atmospheres. Eliminate ignition sources. Take precautions not to handle solid naphthalene in a manner that generates airborne dusts. Wait for molten naphthalene to solidify and cool before attempting removal. Consult qualified experts for advice where necessary.

NAPHTHALENE
Division 4.1 (Flammable Solid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Note that most forms of solid naphthalene are slightly heavier than water and are therefore expected to sink to the bottom of water bodies and dissolve at an extremely slow rate. Although hot molten naphthalene is slightly lighter than water, it is likely to sink as it solidifies in most cases. Be advised, however, that some forms of solid naphthalene may contain sufficient air pockets to permit their flotation. These may require collection from the water surface using various means not discussed below.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . For spilled product that sinks in water, use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface in significant quantities may emit some amounts of toxic vapors if exposed to the open air and permitted to dry.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . According to available data, water containing dissolved naphthalene may potentially be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

NICKEL CARBONYL
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Nickel carbonyl is a clear, colorless to yellow liquid with a musty, stale, sooty odor that some have described as resembling brick dust. It is used for organic synthesis, as a catalyst, and for making high purity nickel powder and nickel coatings. Barely soluble in water and heavier, it can be expected to sink to the bottom of a water body and dissolve very slowly. Its flash point of less than - 4°F indicates that it can be easily ignited under most ambient temperature conditions. Vapors of nickel carbonyl are heavier than air, may travel some distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Some authorities report that containers of liquid may explode if exposed to temperatures at or above 140°F. The product weighs approximately 11 pounds per gallon and is typically shipped in cylinders pressurized with carbon monoxide to a pressure of 15 psig at 68°F, though pressures may increase in storage due to slow decomposition of the product.

Despite its slow decomposition, nickel carbonyl is considered stable in normal transportation. It does not react with water or many other common materials. Reports on its reactivity with air differ. Some authorities state that it reacts slowly with air to produce nickel oxide (dry) and nickel carbonate (wet). Others report that dilute vapors in air will be rapidly decomposed to metallic nickel and carbon monoxide, while some note that nickel carbonyl will form a deposit which becomes peroxidized and which tends to decompose and ignite in the presence of air. The product is reactive with a variety of other chemicals and forms potentially explosive mixtures with several. It may ignite combustible vapors in air in its presence, and must be considered extremely toxic by all routes of exposure. Indeed, it is one of the most hazardous materials in commerce and should be approached and handled with the utmost of care at all times. Special precautions may be necessary to prevent exposure of pregnant women due to the high fetal toxicity of the substance. Note that the volatility of the product indicates that very high concentrations of nickel carbonyl vapors may be present in air.

If nickel carbonyl is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.0176 g/100 g water at 49.64°F (9.8°C); may oxidize somewhat due to air in water.

Solubility in Other Chemicals: Soluble in alcohol, ether, benzene, chloroform, acetone, many other organic solvents, carbon tetra chloride, and concentrated nitric acid.

Specific Gravity (Liquid): 1.32 at 62.6°F (17°C)

Boiling Point: 107.6–109.8°F (42–43.2°C) at 1 atm.

Melting Point: Reported values vary, some give -13°F (-25°C) while others give approximately 2.7°F (19.3°C)

Freezing Point: See melting point

Molecular Weight: 170.73

Heat of Combustion: –1650 cal/g

VaporPressure: 315–330 mm Hg (6.09–6.38 psia) at 68°F (20°C)

Flash Point: Less than –4°F (–20°C)

Autoignition Temperature: Less than 200°F (93.3°C vapor; liquid may possibly explode if confined and heated to 140°F (60°C) or above.

Burning Rate: 2.7 mm/minute

Stability: In the presence of air, nickel carbonyl may form a deposit which becomes peroxidized and which tends to decompose and ignite. See Autoignition Temperature and General Information sections above.

Corrosiveness: Liquid nickel carbonyl and its vapors harden natural rubber and may attack some forms of plastics, rubber, and coatings. Nickel carbonyl is not itself corrosive to metals but some nickel plating of surfaces may occur.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: May form explosive mixtures with tetrachloropropadiene, nitric acid, liquid bromine, chlorine, mixture of n-butane and oxygen, and other oxidizers. Generally incompatible with epoxides, explosives, and polymerizable materials. May ignite combustible vapors in air. Emits carbon monoxide on contact with acid or acid fumes. Ignites in combination with nitrogen tetroxide. Reacts slowly with air. Also see General Information and Stability sections above.

IDENTIFICATION

Shipping Names: Nickel carbonyl (USDOT and IMO)

Synonyms and Tradenames: Nickel tetracarbonyl

Chemical Formula: $Ni(CO)_4$

Constituent Components (% each): Over 99.9% pure in cylinders pressurized with carbon monoxide

UN/NA Designation: UN1259

IMO Designation: 6.1, poisonous substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless to yellow

Odor Characteristics: Musty; stale; sooty; like brick dust

Common Uses: Organic synthesis; making high purity nickel powder and nickel coatings; catalyst

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

NICKEL CARBONYL

Division 6.1 (Poisonous Material)

Square background
applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies widely with individual; reported values range from 0.03 ppm in some data sources to 1- 3 ppm in others.

Unusual Hazards: Extremely toxic, volatile, and flammable liquid. Liquid may possibly explode if heated to 140°F (60°C) or above when confined. Vapors are heavier than air and may persist for a time in pits, hollows, or depressions.

Short Term Exposure Limits (STEL): Unavailable from ACGIH, but note that the NIOSH IDLH for 30 minute exposures is only 0.001 ppm.

Time Weighted Average(TLV-TWA): 0.05 ppm as Nickel over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Exposure to nickel carbonyl is extremely hazardous by all routes of exposure. All exposures should be strictly avoided. Although recent research conflicts with the finding, nickel carbonyl has long been considered a human carcinogen in long-term occupational environments. It is definitely known to cause cancer in laboratory animals and to adversely affect unborn fetuses.

Hazards of Skin or Eye Contact: Contact of liquid nickel carbonyl with the skin may cause irritation, itching, redness, sores, and possibly second and third degree burns. The product can be absorbed through the skin and cause symptoms similar to those of inhalation. Contact of liquid nickel carbonyl with the eyes may be very injurious and minimally cause severe irritation, redness, and sores. Do not wear contact lenses when working with nickel carbonyl .

Hazards of Inhalation: Vapors of nickel carbonyl may cause severe irritation of the eyes and throat. Initial symptoms of over exposure via inhalation typically include frontal headache, giddiness, vertigo, shortness of breath, nausea, vomiting, weakness, sweating, cold and clammy skin, and occasional substernal and epigastric pain. These early effects may be mild at times and usually disappear when the victim is removed to fresh air. Within 12 to 36 hours following exposure, delayed symptoms may appear, including constrictive chest pain characteristic of delayed onset of pulmonary effects such as pneumonitis or bronchopneumonia, as well as leukocytosis, rapid breathing, cough, fever, cyanosis with bluish discoloration of the skin, profound weakness, and possible gastrointestinal symptoms. Except for pronounced weakness and hyperpnea, physical symptoms resemble a viral or influenzal pneumonia. Terminally, delirium and convulsions frequently occur; death due to pneumonitis, respiratory system failure, cerebral hemorrhage, or edema has occurred from 3 to 13 days of exposure. Convalescence of survivors is usually protracted (2 - 3 months) and characterized by excessive fatigue upon exertion. In some cases, the two stages of effects may merge. Note that concentrations of nickel carbonyl as low as 30 ppm have been reported to cause human fatalities after 30 minute exposures.

Hazards of Ingestion: Ingestion of liquid nickel carbonyl may cause irritation of the mouth, throat, and stomach. Although specific data on the degree of hazard by ingestion are not available, it is best to assume that the substance is highly toxic by this route of exposure, possibly causing symptoms of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 2%

Upper Flammable Limit: 34%

Behavior in Fire: Flammable liquid that burns with yellow flame. May generate large quantities of flammable and extremely toxic vapors upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Some authorities claim that containers may explode if heated to temperatures of 140° for above.

Hazardous Combustion Products: Unusually toxic gases may be formed by incomplete combustion. These may include nickel oxide fumes and carbon monoxide and conceivably unburned nickel carbonyl. Exposure to high temperatures may convert nickel carbonyl to metallic nickel and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Some authorities report that containers may explode if heated to temperatures of 140°F or above. Contact with certain chemicals may result in formation of explosive mixtures. See section on Reactivity with Other Chemicals for details.

1259

NICKEL CARBONYL

Division 6.1 (Poisonous Material)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. Compatible materials may include butyl rubber, chlorinated polyethylene, and polyvinyl alcohol. Note that the USDOT and a maker of the product report that normal firefighter's protective clothing may not be effective and that special chemical protective clothing may be necessary under accident conditions. Thus, fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent all contact.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 0.001 ppm), a self-contained breathing apparatus (SCBA) with full face piece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, respiratory tract, or skin; most symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Note: Nickel carbonyl is approximately 100 times more toxic than carbon monoxide. Advise medical professionals, where necessary, that specific antidotes for inhalation include dithiocarb (sodium diethyldithiocarbamate), d-penicillamine, or triethylenetetramine. Dimercaprol (BAL) and disulfiram (Antabuse) are less effective than penicillamine. Dithiocarb is the chelating agent of choice.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Although the above recommendation is from NIOSH, be aware that at least one manufacturer of nickel carbonyl recommends that vomiting should not be induced. Seek immediate medical advice on this issue if possible, realizing that both courses of action have different risks and benefits to the victim.)

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may not be fully effective due to the insolubility of the product, but note that liquid nickel carbonyl is heavier than water and that contained pools may possibly be carefully covered with a layer of water to reduce fire risks where foam is not available. Note also that there is some disagreement among authorities as whether alcohol or regular foam is most suitable.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may explode if exposed to excessive heat for sufficient time duration. Use water from a safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other down stream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment where necessary. Take the extremely toxic, flammable, explosive, and reactive nature of nickel carbonyl into account while planning the response. Note that heavier than air vapors may persist for a time in pits, hollows, and depressions.

NICKEL CARBONYL
Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Nickel carbonyl discharges may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nickel carbonyl vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of nickel carbonyl from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of nickel carbonyl vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution. Be aware that some authorities suggest the use of alcohol foam instead of regular foam.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER APPLICATION . . . There is a possibility that application of water to the surface of contained liquid pools of nickel carbonyl may reduce emissions of vapors. Since liquid nickel carbonyl is somewhat heavier than water and practically insoluble, a carefully applied layer of water may serve to suppress vapor evolution from contained pools.

CONSEQUENCE

Addition of water will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Nickel carbonyl may be contained by building dikes or barriers using soil, sand or other materials. Note that liquid nickel carbonyl is highly volatile and has a boiling point in the range of 107.6–109.8°F. The product will vaporize rapidly under most ambient temperature conditions.

CONSEQUENCES

Contained nickel carbonyl may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

NICKEL CARBONYL
Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, vermiculite, wood fibers, straw, saw dust, compatible commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

NICKEL CARBONYL
Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination. (Note: Nickel carbonyl will dissolve extremely slowly from the bottom of the water body. Some small amounts may react with air dissolved in the water to form nickel oxide and nickel carbonate.)

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit highly toxic or flammable vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGA TION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

CHEMICAL TREATMENT . . . Application of appropriate chemical agent(s) to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

NITRATING ACID
Class 8 (Corrosive Material)

GENERAL INFORMATION

Nitrating acid is a colorless to light yellow or gray to reddish brown mixture of sulfuric acid and nitric acid that may contain some amount of dissolved sulfur trioxide. It is used as an industrial oxidizing and nitrating agent in chemical reactions. It is fully soluble but may react violently upon contact with water with the production of heat, fumes, and spattering. Although nitrating acid is not combustible, contact with various metals may generate flammable and potentially explosive hydrogen gas as well as toxic nitrogen oxides. In addition, the product is a strong oxidizing agent that may ignite or react violently or explosively with combustible or reactive materials and may accelerate their burning. There is some limited potential that containers of the product may rupture due to overpressurization and release toxic nitrogen oxides if exposed to fire or excessive heat for suffcient time duration. The product weighs approximately 12.7-15.9 pounds per gallon depending on composition. Its fumes and vapors may be heavier than air.

Nitrating acid is highly corrosive to most metals and is also highly corrosive to bodily tissues. Products of decomposition in a fire may include toxic oxides of nitrogen.

If nitrating acid is in a mixed load shipment (small packages shipped with other small packages in the same outer packaging, railcar, container, or trailer) and exposed to fire or direct flame, evacuate for a radius of 1500 feet. (Note: See the guides in the series for nitric acid, sulfuric acid, and oleum for additional information on the components of nitrating acids. The composition of such acids is variable and may include 10-90% nitric acid, 10-90% sulfuric acid, and 0-30% sulfur trioxide.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions but reacts violently (see below.)
Solubility in Other Chemicals: Data unavailable
Specific Gravity (Liquid): Approx 1.53-1.79
Boiling Point: 179.6-206.6°F (82-97°C) at 1 atm.
Melting Point: Variable, but approx. – 49°F (– 45°C)
Freezing Point: Variable, but approx. – 49°F (– 45°C)
Molecular Weight: 63.01 (nitric acid); 98.08 (sulfuric acid) 80.06 (sulfur trioxide)
Heat of Combustion: Not flammable
Vapor Pressure: 1-45 mm Hg (0.0193 - 0.870 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Normally stable
Corrosiveness: Highly corrosive to most metals with the generation of hydrogen gas and toxic nitrogen oxides. May attack some forms of plastics, rubber, and coatings
Reactivity with Water: Reacts violently with the production of heat, fumes, and spattering.
Reactivity with Other Chemicals: Reacts with most metals, bases, carbides, hydrogen sulfide, oxidizable inorganic compounds, organic acids, and combustible organic materials. Combustible or oxidizable materials (including powered metals) may be ignited or may react explosively.

IDENTIFICATION

Shipping Names: Nitrating acid , mixtures (USDOT and IMO);
Synonyms and Tradenames: Mixed acid; acid mixtures; nitric-sulfric and mixtures. nitric-sulfuric acid mixtures.
Chemical Formula: HNO_3 (nitric acid); H_2S0_4 (sulfuric acid); SO_3 (sulfric trioxide).
Constituent Components (% each): 10-90% HNO_3; 10-90% H_2SO_4; 0-30% SO_3.
UN/NA Designation: UN1796
IMO Designation: 8, corrosive
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to light yellow or gray to reddish brown.
Odor Characteristics: Acrid
Common Uses: Industrial oxidizing and nitrating acid.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

NITRATING ACID

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive acid. Reacts violently with water. May ignite or react explosively or violently with combustible or oxidizable materials and may increase their flammability. Evolves hydrogen gas and toxic nitrogen oxides in contact with most metals.

Short Term Exposure Limits(STEL): 4 ppm (10 mg/m^3) nitric acid for 15 minutes (ACGIH). Unavailable for sulfuric acid.

Time Weighted Average(TLV-TWA): 2 ppm (5 mg/m^3) nitric acid or 1 mg/m^3 sulfuric acid over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat or fire; sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure. Vapors and fumes in air may include toxic oxides of nitrogen as well as nitric and sulfuric acids.

Hazards of Skin or Eye Contact: Contact of liquid nitrating acid or its concentrated vapors or fumes in air with the skin or eyes may result in immediate, severe and deep burns. Ths skin may be ulcerated and stained a yellow or yellowish brown color. The eyes may be permanently damaged.

Hazards of Inhalation: Vapors or fumes of nitrating acid in air may cause irritation and burns of the nose, mouth, throat, and respiratory system as well as erosion of exposed teeth. Exposure to high concentrations in air may also cause lung irritation, nitrogen oxide poisoning, and pulmonary edema and pneumonitis with possibly severe consequences. Onset of the latter effects may be delayed for 4-30 hours.

Hazards of Ingestion: Ingestion of nitrating acid may result in immediate pain and burns of the mouth, esophagus and gastrointestinal tract, perforation of the esophagus or stomach; staining and erosion of teeth; nausea and vomiting of blood and tissue; and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: There is some limited potential that containers may rupture violently in fire due to overpressurization. May generate large quantities of toxic and corrosive vapors and fumes upon release.

Hazardous Combustion Products: Decomposition products include toxic nitrogen oxides.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: There is some limited potential that containers may rupture violently in fire due to overpressurization. Contact with numerous other chemicals and materials may result in violent or explosive reactions. Contact with most metals produces hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene, nitrile rubber, chlorinated polyethylene, polyvinyl chloride, Viton, and nitrile-butadiene rubber for concentrated (more than 70%) acids.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 mg/m^3 total acid), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations a gas mask with chin-style or front or back mounted canister and high efficiency particulate filter within the use limitations of these devices. The canister should provide protection against nitric and sulfuric acids and should not contain oxidizable materials such as activated charcoal.

1796

NITRATING ACID
Class 8 (Corrosive Material)

FIRST AID

Nonspecific symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Avoid giving carbonates.)

FIRE RESPONSE

Extinguishing Materials: Water spray in flooding quantities is recommended, but apply water cautiously since it may react violently with spilled acid.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that nitrating acid is highly corrosive and reactive. Contact with most metals may produce flammable and potentially explosive hydrogen gas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Nitrating acid spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large quantities have spilled and/or large amounts of fumes and vapors are evolved.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Nitrating acid may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled or the acid is not fuming.

CONSEQUENCE

Hazardous levels of nitrating acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

NITRATING ACID
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nitrating acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of concentrated acid as this may increase fume evolution,

CONSEQUENCE

Water runoff may contain nitrating acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid nitrating acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid nitrating acid may eventually slow the release of vapors or fumes into the atmosphere. This response has special risks and is better suited to smaller spills.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Nitrating acid may react violently with water.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Nitrating acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained nitrating acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

NITRATING ACID
Class 8 (Corrosive Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

NITRATING ACID
Class 8 (Corrosive Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGA TION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land. (Note: Anion exchangers may be necessary to capture nitrates formed during neutralization.)

March 1995

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

GENERAL INFORMATION

Fuming nitric acid is a colorless to pale yellow to reddish brown liquid that has a sweet to acrid odor and may fume in air. It is used to make various fertilizers, explosives, dyes, chemicals, pesticides, and rocket fuels and is also used for etching, bright-dipping, electroplating, and photoengraving. It is fully soluble in water but also reacts to produce heat and toxic and corrosive fumes. Although the product is not combustible, contact with many metals may generate flammable and potentially explosive hydrogen gas as well as toxic nitrogen oxides. In addition, the product is a strong oxidizing agent that may ignite or react explosively or violently with combustible or reactive materials and may accelerate their burning. There is some limited potential that containers may rupture due to overpressurization and release toxic nitrogen oxides if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 12.4-12.6 pounds per gallon. Its fumes and vapors may be heavier than air.

Fuming nitric acid is very corrosive to wood, paper, cloth, and most metals, and may also attack some forms of plastics, rubber, and coatings. Contact with such materials or heating of the liquid may generate toxic red oxides of nitrogen into the air. The product is also highly corrosive to bodily tissues.

Downwind evacuation should be considered if fuming nitric acid is leaking from its container. If nitric acid, fuming is in a mixed load shipment (small packages shipped with other small packages in the same outer packaging, railcar, container, or trailer) and exposed to fire or direct flame, evacuate for a radius of 1500 feet. If the material is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions but also reacts (see below).
Solubility in Other Chemicals: Soluble in ether.
Specific Gravity (Liquid): 1.49-1.55 for 95% or more HNO_3
Boiling Point: 190.4-203°F (88-95°C) at 1 atm.
Melting Point: – 59.8 to – 49°F (– 45 to – 51°C)
Freezing Point: – 59.8 to – 49°F (– 45 to – 51°FC)
Molecular Weight: 63.01 HNO_3
Heat of Combustion: Not flammable
Vapor Pressure: 47.9 mm Hg (0.926 psia) at 68°F (20°C) for 100% HNO_3; up to 103 mm Hg (1.99 psia) for red fuming HNO_3.
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Evolves toxic red oxides of nitrogen when heated.
Corrosiveness: Very corrosive to wood, paper, cloth, and most metals. May attack some plastics, rubber, and coatings. Compatible with aluminum or stainless steel.
Reactivity with Water: Produces heat and toxic and corrosive fumes.
Reactivity with Other Chemicals: Reacts with a wide variety of metals (especially when powdered), bases, carbides, cyanides, sulfides, fulminates, picrates, chlorates, oxidizable inorganics, organic chemicals, turpentine, and combustible materials. Many substances may be ignited or may react violently or explosively.

IDENTIFICATION

Shipping Names: Nitric acid, red fuming (USDOT and IMO)
Synonyms and Tradenames: Hydrogen nitrate; Aqua fortis; Azotic acid; Nital; nitryl hydroxide; white fuming acid; red fuming acid.
Chemical Formula:: HNO_3
Constituent Components(% each): 95-99% pure
UN/NA Designation: UN2032
IMO Designation: 8, corrosive
Physical Shte as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to pale yellow to reddish brown
Odor Characteristics: Acrid, sweet to acrid, suffocating
Common Uses: Mfg. fertilizers, explosives, dyes, chemicals, pesticides, and rocket fuels; used for etching, bright-dipping, electroplating, photoengraving, and metal cleaning

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive acid. May ignite or react explosively or violently with combustible or oxidizable materials and may increase their flammability. Evolves hydrogen gas and toxic nitrogen oxides in contact with most metals.

Short Term Exposure Limits(STEL): 4 ppm (10 mg/m^3) for 15 minutes. (ACGIH)

Time Weighted Aversge(TLV-TWA): 2 ppm (5 mg/m^3) over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat or fire; sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure. Vapors and fumes in air include toxic oxides of nitrogen as well as nitric acid.

Hazards of Skin or Eye Contact: Contact of fuming nitric acid or its concentrated vapors or fumes in air with the skin or eyes may result in immediate, severe and deep burns. Ths skin may be ulcerated and stained a yellow or yellowish brown color. The eyes may be permanently damaged.

Hazards of Inhalation: Vapors or fumes of nitric acid in air may cause irritation or burns of the nose, mouth, throat, and respiratory system as well as erosion of exposed teeth. Exposure to high concentrations in air may also cause lung irritation, nitrogen oxide poisoning, and pulmonary edema and pneumonitis with possibly severe consequences. Onset of the latter effects may be delayed for 4-30 hours.

Hazards of Ingestion: Ingestion of nitric acid may result in immediate pain and burns of the mouth, esophagus, and gastrointestinal tract, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: There is some limited potential that containers may rupture violently in fire due to overpressurization. May generate large quantities of toxic and corrosive vapors and fumes upon release.

Hazardous Combustion Products: Decomposition products include toxic nitrogen oxides.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: There is some limited potential that containers may rupture violently in fire due to overpressurization. Contact with numerous other chemicals and materials may result in violent or explosive reactions. Contact with most metals produces hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include natural rubber, neoprene, nitrile rubber, polyethylene, chlorinated polyethylene, polyvinyl chloride, Viton, nitrile-butadiene rubber, and Saranex for concentrated (more than 70%) nitric acid.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister or a chemical cartridge respirator with a full facepiece within the use limitations of these devices. The canister or cartridge should provide protection against nitric acid and should not contain oxidizable materials such as activated charcoal.

2032

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

FIRST AID

Nonspecific symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Avoid giving carbonates such as baking soda.)

FIRE RESPONSE

Extinguishing Materials: Apply water spray in flooding quantities, but note reactivity with water.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that fuming nitric acid is highly corrosive and reactive. Contact with most metals may produce flammable and potentially explosive hydrogen gas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Nitric acid spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nitric acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of nitric acid as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain nitric acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION...Application of an appropiate neutralization to liquid nitric acid may eventually slow the release of vapors or fumes into the atomsphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid nitric acid may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Nitric acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained nitric acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

NITRIC ACID, RED FUMING
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land. (Note: Anion exchangers may be necessary to capture nitrates formed during neutralization.)

October 1991

NITRIC OXIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Nitric oxide has a normal boiling point of approximately –240°F and a critical temperature of approximately –135°F. It is therefore normally shipped as a compressed nonflammable poisonous gas in steel cylinders or tank cars (ton containers). The gas is itself colorless but may become reddish-brown at higher concentrations upon release as it reacts with oxygen in the air to form nitrogen dioxide and nitrogen tetroxide. Nitric oxide is practically insoluble in water but the nitrogen oxides it forms with oxygen are considerably more soluble and form nitric and nitrous acids. The odor of the gas has variably been described as sharp, sweet, acrid, unpleasant, pungent, and mildly irritating. Nitric oxide is used to make or stabilize a variety of other chemicals, for bleaching rayon, and for calibration of air pollution measurement instruments. (Note: See the Guide for nitrogen tetroxide for additional information on the properties and hazards associated with nitrogen dioxide and tetroxide.)

The gases of concern are heavier than air and may persist in pits, hollows, and depressions. Since cylinders and other containers used in transportation of nitric oxide are not equipped with pressure relief devices, excessive exposure to fire or heat is more likely than usual to result in violent rupture and possible rocketing of the container, due not only to overpressurization but also to instability of the compressed gas at high pressures and temperatures.

Since nitric oxide is shipped at temperatures far in excess of its critical temperature, this being the temperature above which it cannot be liquefied regardless of the pressure applied, the weight of gas within a container is a function of the volume of the container, the temperature of the gas, and the degree to which the container is pressurized. As best as can be determined, the maximum pressure allowed in a cylinder is 750 psig (about 52 atm) at 70°F, but many shippers do not pressurize above 500 psig (about 35 atm). Shipments in tank cars are reported to be pressurized to no more than 200 psig (about 14.6 atm).

Nitric oxide is not itself combustible, but it and the other nitrogen oxides it forms in air are extremely reactive oxidizers that may cause fire or explosion upon contact with combustible or oxidizable materials and will support and accelerate their burning. Nitric oxide gas is not corrosive to most structural materials when dry. In the presence of moisture, however, the formation of nitric and nitrous acids may develop corrosive conditions. Nitric oxide and the other gaseous nitrogen oxides of concern are extremely toxic and dangerous if inhaled or contacted. (Note: Although not fully applicable to transportation of the compressed gas, it is well to be advised that liquid nitric oxide is very sensitive to detonation, even in the absence of a fuel.)

If nitric oxide is leaking from its container, downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions. A large release may require an evacuation or protective action zone measured in miles. Evacuation may also become necessary if a container is exposed to direct flame or a fire becomes uncontrollable, not only for protection from flying debris if the container should rupture violently, but also because a large amount of non-flammable but extremely toxic gases may be suddenly released to the atmosphere.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.00618 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Reported to be soluble to some degree in alcohol, carbon disulfide, sulfuric acid, and aqueous solutions of ferrous sulfate ($FeS0_4$). Be advised that nitrogen oxides may react with alcohols or carbon disulfide according to some authorities.

Specific Gravity (Liquid): 1.27 at –238.4°F (–150.2°C)

Boiling Point: –241.6 to –239.8°F (–152 to –151°C) at 1 atm.

Melting Point: –263.2 to –257.8°F (–164 to –161°C)

Freezing Point: See melting point

Molecular Weight: 30.01

Heat of Combustion: Not flammable

Vapor Pressure: Approx 64.6 atm (949.4 psia) at –135.2°F (–91.2°C). This is the critical pressure and related critical temperature of nitric oxide. See the General Information section above for further details.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable in normal transportation when sealed in gas-tight container. Will react with oxygen in air upon release to form nitrogen dioxide (NO_2) gas which will itself partially convert to nitrogen tetroxide (N_2O_4). These gases may appear as reddish-brown in air if present in sufficient concentration.

Corrosiveness: Nitric oxide is not corrosive to most common metals of construction when pure. In the presence of oxygen and moisture, however, corrosive conditions will develop due to the formation of nitric and nitrous acids. Nitric oxide will attack some forms of plastics, rubber, and coatings.

Reactivity with Water: Any nitric oxide that dissolves in water will form corrosive nitric and nitrous acids in a reaction that is reported not to be violent.

Reactivity with Other Chemicals: The NO_2 which forms when nitric oxide (NO) combines with oxygen, as well as NO itself, are strong oxidizing agents with potential to react violently, ignite, or explode in contact with numerous combustible and/or oxidizable materials.

IDENTIFICATION

Shipping Names: Nitric oxide (USDOT and IMO); mixtures of nitric oxide and nitrogen tetroxide may be shipped as "poisonous gas, n.o.s." under USDOT regulations but shipping papers are required to indicate the specific constituents of the cargo in such cases.

Synonyms and Tradenames: Nitrogen monoxide; nitrogen oxide; mononitrogen monoxide; nitrogen (II) oxide

Chemical Formula: NO

Constituent Components (9c each): When shipped as nitric oxide, the product is typically 98.5% or more pure. It may also be shipped as various mixtures with nitrogen tetroxide.

49 STCC: 49 203 30 (nitric oxide); 4920370 (nitric oxide and nitrogen tetroxide mixtures)

UN/NA Designation: UN1660 (USDOT and IMO for nitric oxide); NA1955 (USDOT for nitric oxide and nitrogen tetroxide mixtures shipped as "poisonous gas, n.o.s."); UN1975 (IMO for nitric oxide and nitrogen tetroxide mixtures).

IMO Designation: 2.3, poison gas

Physical State As Shipped: Compressed gas

Physical State As Released: Gas; may possibly form some liquid droplets of nitrogen tetroxide in air under appropriate environmental and discharge conditions.

Color of the Shipped Material: Colorless gas that may become reddish-brown at higher concentrations as it reacts with oxygen in air to form nitrogen dioxide. Deep blue when liquid or bluish-white snow when solid at very low temperatures.

Odor Characteristics: Variably described as sharp, sweet, acrid, unpleasant, pungent, and irritating.

Common Uses: Making nitric acid, nitrosyl carbonyls, and a variety of other chemicals; bleaching rayon.

See UN/NA Designation for other ID numbers.

NITRIC OXIDE
Division 2.3 (Poison Gas)

Square background applicable to rail cars.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reported data vary; one source says the odor of NO_2 is perceptible to some people at 0.11 ppm and for most at 0.22 ppm. Others list an odor threshold of 5 ppm.

Unusual Hazards: Extremely toxic compressed gas that may be dangerous over very considerable downwind distances depending on location, rate and duration of release, as well as weather conditions. Lethal doses may be inhaled before a victim experiences any significant discomfort. A highly reactive and strong oxidizing agent. Nitric oxide gas and its reaction products with oxygen may be heavier than air and persist in low areas.

Short Term Exposure Limits (STEL): Not established for nitric oxide; 5 ppm as NO_2 for 15 minutes (ACGIH, 1990–91); 1 ppm for 15 minutes as NO_2 (OSHA, 1989).

Time Weighted Average (TWA) Limits: 25 ppm as nitric oxide or 3 ppm as NO_2 over each 8 hours of a 40 hour work week (ACGIH TLV, 1990–91); 25 ppm as nitric oxide (OSHA PEL, 1989) under similar circumstances. OSHA permitted a transitional ceiling limit for NO_2 of 5 ppm in 1989 which will be phased out over time in favor of the STEL reported above.

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff of contaminated water to sewers or water bodies; direct physical contact or inhalation.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of nitric oxide gas and its products in combination with oxygen in even low concentrations. Significant discharges may be highly dangerous at the spill site and over considerable distances downwind. Direct contact of the gas with the skin and particularly the eyes should also be strictly avoided. Note that the following discussions are generalized in order to address the mixture of nitrogen oxides that may be present in air following a discharge of gaseous nitric oxide.

Hazards of Skin or Eye Contact: The gases of concern are extremely irritating to the eyes, nose, throat, and skin. Excessive contact with the skin may result in burns; one authority states that prolonged or widespread skin contact may result in absorption of potentially harmful amounts. Contact with the eyes may cause severe irritation or possibly permanent injury involving marked redness, swelling, and opecification of the cornea; only 70 ppm of nitrogen tetroxide vapors in air for 8 hours were required to cause persistent corneal opacification in the eyes of rabbits that survived the experiment; higher concentrations may possibly cause this effect in far less time.

Hazards of Inhalation: Depending on the level and duration of exposure, these gases and vapors may cause different responses in victims. At high levels in air, symptoms potentially include irritation of the eyes, nose and throat, drowsiness, dizziness, headache, tightness and/or burning in the chest, coughing, choking, production of frothy or mucoid sputum, salivation, restlessness, anxiety, mental confusion, nausea, vomiting, tremors, incoordination, cyanosis, fatigue, increasing and/or irregular respiratory and heart rates, difficulty in breathing, and lung airway constriction resulting in asphyxiation, convulsions, coma and possibly rapid death. For example, exposure of mice to 5000 ppm of nitric oxide for 6 to 8 minutes was fatal, as was exposure to 2500 ppm for 12 minutes. Cyanosis occurred after a few minutes; breathlessness, paralysis, convulsions and death followed. Substantially lower concentrations can result in delayed pulmonary edema and death, often with little or no initial symptoms or warning signs. For example, breathing as little as 25 ppm of nitrogen oxides for 8 hours, 100 to 150 ppm for 30 to 60 minutes, or just a few breaths at 200 to 700 ppm, may cause severe effects after a latent period of as little as 2 hours, 5 to 8 hours (apparently most typical), or as long as 48 hours in which there are few significant symptoms (if any) and the victim may feel well. The respiratory system effects discussed above will suddenly appear after this period and may ultimately cause death. In yet other cases, there may be mild or moderate signs of injury immediately after the exposure. These will disappear over a period of 2 to 3 weeks, only to be followed by sudden onset of fever, chills, increasing difficultly in breathing, increasing cyanosis, pulmonary edema, and possibly death. Survivors usually recover in another 2 to 3 weeks; however, some do not return to normal but experience varying degrees of impaired lung function. Pneumonia is a general threat from all major exposures. Other significant observations are that: 1) NO_2 exposures may decrease resistance to pulmonary infection; 2) severity of the pulmonary reaction may be lessened if the victim avoids exertion after exposure; 3) just a few ppm in air (e.g., 4–5 ppm of NO_2 for 15 minutes) may rapidly cause increased resistance to the flow of air and other effects in the respiratory systems of healthy adults; 4) inhalation of nitrogen oxides at very low concentrations (e.g., 0.1 ppm of NO_2 for 2 hours) may aggravate the conditions of people with "reactive airway disease", including those who suffer from asthma, chronic bronchitis, or inflammatory or fibrotic pulmonary disease; and 7) survivors of significant exposures may occasionally develop "bronchiolitis fibrosa obliterans" (fibrotic lesions in the lungs) between 10 days to 6 weeks after resolution of acute symptoms.

Hazards of Ingestion: Since it is not normally shipped as a liquid or solid, and due to its very low boiling point, ingestion of nitric oxide is extremely unlikely.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable gas that is a strong oxidizer and may support and possibly greatly intensify surrounding fires upon release. There is a possibility that some substances that do not normally burn in air will ignite or explode in a highly oxidizer enriched atmosphere. Containers may rupture violently and possibly rocket in a fire, suddenly releasing large quantities of extremely toxic oxidizing gases into the atmosphere.

1660

NITRIC OXIDE
Division 2.3 (Poison Gas)

See UN/NA Designation for
other ID numbers.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable
Upper Explosive Limit: Not flammable
Explosiveness: Containers of nitric oxide do not normally have pressure relief valves or devices. They may rupture violently in a fire and possibly rocket. The gases of concern are strong oxidizers that may possibly cause a wide variety of materials to ignite or explode upon contact when in high concentrations in the atmosphere. Be advised that any liquid nitric oxide that may be encountered in non-transportation situations may be very sensitive to detonation even in the absence of a fuel.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with nitric oxide. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing for normal working conditions. Several authorities strongly recommend the use of fully encapsulating suits with self-contained breathing apparatus (SCBA) to prevent contact with the gas concentrations that may result in air from discharges. Compatible materials for nitric oxide may include butyl rubber, polyvinyl chloride (PVC), and chlorinated polyethylene. Compatible materials for nitrogen tetroxide may include chlorinated polyethylene, polyethylene, chlorobutyl rubber, and CR 39.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister (5 ppm or less) containing non-oxidizable sorbents and providing protection against the nitrogen oxides of concern or a chemical cartridge respirator (5 ppm or less) with a full facepiece and cartridges) containing non-oxidizable sorbents and providing protection against the nitrogen oxides of concern within the use limitations of these devices. Nitrogen oxides are oxidizers and should not come in contact with oxidizable materials. Some cartridges and canisters may contain oxidizable materials such as activated charcoal or carbon and should therefore not be used to provide protection against these contaminants. (Note: NIOSH recommendations for pure nitric oxide are less strict than those presented here. The above recommendations acknowledge that considerable amounts of nitric oxide may combine with oxygen in air upon release to form nitrogen dioxide and nitrogen tetroxide. They were extracted from NIOSH documents discussing protection from nitrogen dioxide.)

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, nose, throat, or skin; other symptoms of exposure to the nitrogen oxides of concern.
First Aid for Inhalation: Anyone exposed even momentarily to high concentrations of nitrogen oxides in air should receive immediate attention. Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Get medical attention immediately. Qualified personnel should administer oxygen as soon as possible to prevent or minimize the possibility of pulmonary edema. Keep the victim warm, quiet, and under medical observation until the danger of delayed pulmonary edema has passed (at least 72 hours). Physical exertion should be discouraged as it may increase the severity of resulting pulmonary edema or chemical pneumonitis. Note that there are specific medical treatments recommended for exposure to these substances.
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention immediately.

FIRE RESPONSE ,

Extinguishing Materials: Authorities disagree. The USDOT (1990) recommends that only water spray or fog be used on small fires or where a fire must otherwise be fought. It specifically says not to apply dry chemical, carbon dioxide or Halon, but its rationale for avoiding all alternatives is unclear. Others recommend use of water, foam, carbon dioxide, or dry chemical on surrounding fires as necessary. It would appear best to follow USDOT recommendations or to use other extinguishing agents with due caution. In particular, note that certain Halons have the potential to react violently with the nitrogen oxides of concern.
Extinguishing Techniques: Unusual toxic gas, corrosive fume, and oxidizing agent hazard. Keep combustible and oxidizable materials away from discharge. Stop leak if you can do it without risk. Stay upwind. Wear breathing apparatus and appropriate protective clothing, including fully-encapsulating vapor-protective suit where contact with material is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may rupture violently, possibly rocket, and suddenly release massive amounts of product when exposed to high heat. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

NITRIC OXIDE
Division 2.3 (Poison Gas)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area and out of low areas. Avoid all contact with discharged product. Eliminate ignition sources. Stop leak if safe to do so. Prevent concentrated gas from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff where acids may form due to use of water spray or fog in a highly contaminated atmosphere. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water where significant runoff occurs. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Since reverse flow into a cylinder may cause rupture, use a check valve or other protective device in any line or piping from a cylinder to prevent reverse flow. Take the extremely toxic and reactive nature of nitric oxide and its products in combination with oxygen into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow gas to dissipate. Nitric oxide discharges may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nitrogen oxides in air may absorb gases and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain corrosive nitric and nitrous acids from contact with airborne gases.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible (see below) to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Water runoff that is significantly contaminated with nitric and nitrous acids and deemed to pose a public safety or environmental threat may be contained by building dikes using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods. (Note: The recommendations provided here and below for containment and cleanup of contaminated runoff resulting from the use of water sprays may not be necessary in all cases. Seek guidance from a qualified expert where necessary.)

CONSEQUENCE

Contained acids may percolate into soil or seep through dike material. This may result in loss of contained liquids and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as excessive fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

NITRIC OXIDE
Division 2.3 (Poison Gas)

TECHNIQUE

EXCAVATION . . . Where deemed necessary, a trench or ditch may be excavated to contain contaminated runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Where deemed necessary, accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the nitric and nitrous acids may be corroded or otherwise damaged. Leaks may develop.

MITIGATION

Use equipment compatible with nitric and nitrous acids.

TECHNIQUE

ABSORPTION . . . Where deemed necessary, spreading of liquids may be controlled by absorbing them with sand, earth, clay, fly ash, cement powder, vermiculite, perlite, compatible commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the contaminated liquids. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under the guidance of a qualified expert. Note that noncombustible sorbents should be used in order to reduce the risk of fire.

TECHNIQUE

NEUTRALIZATION . . . Where deemed necessary, application of an appropriate neutralization agent may modify the contained acids to less hazardous substances.

CONSEQUENCE

Application and removal of chemical neutralization agents may entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Where deemed necessary, contaminated soil and liquid residues may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Certain oxidizable substances that have been exposed to the nitrogen oxides and acids of concern may possibly be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with nitric and nitrous acids. Store contaminated materials in a safe and secure location. Do not operate motorized equipment where their use may lead to ignition of combustible materials. Consult qualified experts for advice where necessary.

NITRIC OXIDE
Division 2.3 (Poison Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Where significantly contaminated water runoff has entered a body of water, notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: This recommendation and those that follow may not be required in some cases if contaminants will be diluted below harmful levels. Seek guidance from a qualified expert where necessary.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Where necessary, contaminated water may be contained (or diverted to an impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Where necessary, application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

ortho-NITROANILINE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Nitroaniline (ortho isomer) is a reddish orange or yellowish gold colored crystalline solid with an odorless or musty odor. It is used for making dyes, explosives, photo anti-fogging agents and various other chemicals, and may be shipped as a molten liquid. It is very slightly soluble in water and heavier, so may be expected to sink and then dissolve at a very slow rate. Its flash point of 266°F indicates that the product must be preheated before ignition may occur easily. There is a limited possibility that containers may rupture violently at very high temperatures. The product weighs approximately 78-90 pounds per cubic foot as a solid.

Ortho-nitroaniline does not react with water, is relatively noncorrosive at ambient temperatures, and is stable in normal transportation. Reactions with chlorine trifluoride, caustics, alkali and alkaline earth elemental metals, nitrides, strong oxidizers, or strong reducing agents may be explosive, and the product is reactive with a variety of other chemicals. There is some indication that contact with organic materials in the presence of moisture may result in spontaneous combustion. The product is a highly toxic substance and considered a poison. Products of combustion are toxic and may include nitrogen oxides.

If ortho-nitroaniline is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 4700 ppm at 77°F (25°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.

Specific Gravity (Solid): 1.25-1.44 at 60°F (15.5°C)

Boiling Point: 543°F (284°C) at 1 atm. (may decompose)

Melting Point:: 160.7°F (71.5°C)

Freezing Point: 160°F (71°C)

Molecular Weight: 138.13

Heat of Combustion: – 5544 cal/g

Vapor Pressure: Less than 0.1 mm Hg at 86°F (30°C); 1 mm Hg (0.019 psia) at 219.2°F (104°C)

Flash Point: 266°F (130°C), open cup (lowest found).

Autoignition Temperature: 970°F (521°C)

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Not corrosive at ambient temperatures. Can be handled in mild steel with only color degradation. Can also use glass or type 304 or 316 stainless steel.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: May react with chlorine trifluoride, acids, aldehydes, halogenated organics, peroxides, alkali or alkaline earth elemental metals, strong reducing agents, strong oxidizers, epoxides, isocyanates, dithiocarbamates, nitrides, and possibly organic materials.

IDENTIFICATION

Shipping Names: Nitroanilines (USDOT & IMO)

Synonyms and Tradenames: Aniline, 2-nitro; 2-nitroaniline; 1-amino-2-nitrobenzene; o-nitroaniline; numerous tradenames with words fast orange or orange, GR or JR, and base or salt.

Chemical Formula: $NO_2C_6H_4NH_2$

Constituent Components(% each): Almost 100% pure with traces water and organic impurities.

UN/NA Designation: UN1661

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Solid, or molten liquid.

Physical State as Released: Solid, or molten liquid that freezes.

Color of the Shipped Material: Reddish orange; yellowish gold; orange.

Odor Characteristics: Musty or odorless

Common Uses: Mfg. of dyes, explosives, photo anti-fogging agent, coccidiostat, benzotriazole, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:

CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ortho-NITROANILINE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Highly toxic substance that affects ability of blood to carry oxygen. Effects are more dangerous than readily apparent and may be delayed up to 4 hours. Ingestion of alcohol may aggravate toxic effects.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable. TLV for para isomer is 0.5 ppm or 3 mg/m^3 over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of vapors or dust in air or ingestion. Prolonged contact with the skin and eyes are also to be avoided. Liver damage is a possibility if exposures are prolonged or severe.

Hazards of Skin or Eye Contact: Contact of the skin with o-nitroaniline may cause irritation and the product may be absorbed through the skin in toxic amounts to cause cyanosis. Contact with the eyes may result in corneal injury.

Hazards of Inhalation: Causes cyanosis and thereby affects the ability of the blood to carry oxygen. Symptoms include irritation of mucous membranes, irregular pulse, bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, unconsciousness, and possibility of death if treatment is not prompt. Effects may be delayed up to 4 hours and are aggravated by ingestion of alcohol.

Hazards of Ingestion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Will burn but difficult to ignite. There is a limited potential that containers may rupture violently in fire due to overpressurization.

Hazardous Combustion Products: Toxic, may include nitrogen oxides.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: There is a very limited potential that containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Explosion may result if vapors from hot liquid are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials include neoprene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency particulate filter respirator with a full facepiece might be adequate within the use limitations of these devices.

1661

ortho-NITROANILINE

Division 6.1 (Poisonous Material)

FIRST AID

Nonspecific symptoms: Eye or skin irritation; symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contct: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention as necessary to cleaning hair and scalp, finger and toenails, nostrils and ear canals.)

First Aid for Ingestion: If victim is conscious, administer a strong solution of salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, dry chemical, carbon dioxide, water spray or fog.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the significant toxicity of ortho-nitroaniline into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Ortho-nitroaniline may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ortho-nitroaniline in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid ortho-nitroaniline with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

ortho-NITROANILINE

Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or dusts in air or the surface of the spilled product may reduce downwind concentrations.

CONSEQUENCE

Water runoff may contain a small amount of ortho-nitroaniline from contact with the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . ortho-Nitroaniline may be contained by building dikes or barriers using soil, sand or other materials. Liquids should solidify fairly rapidly.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. Equipment can become clogged if product freezes.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product. Act promptly and prevent freezing if possible.

TECHNIQUE

ABSORPTION . . . Spreading of liquid product may be controlled by absorbing liquid with sand, earth, clay, fly ash or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means after product has frozen.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause toxic dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

ortho-NITROANILINE

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

NITROBENZENE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Nitrobenzene is a water-white or light greenish yellow to brownish oily liquid with an almond or bitter almond odor resembling paste shoe polish. It is used as a solvent, in oil refining, and for making dyes, rubber chemicals, drugs, metal and shoe polishes, TNT, and a variety of other chemicals. Being somewhat heavier than water and very slightly soluble, it can be expected to sink and then dissolve at a very slow rate. Its flash point of 171°F indicates that the product must be moderately heated before it can be ignited easily. There is a limited potential that containers of liquid may rupture at temperatures above 572°F. The product weighs approximately 10 pounds per gallon.

Nitrobenzene is stable in normal transportation and does not react with water or other common materials. Reactions with aluminum chloride and phenol, aniline and glycerin, nitric acid, nitrogen tetroxide, or silver perchlorate may be explosive, however, and the product is incompatible with strong oxidizers, and caustics in the presence of metals such as tin or zinc. It may attack some forms of plastics, rubber, and coatings and must be considered highly toxic by all routes of exposure. Products of combustion may be toxic and may include nitrogen oxides and carbon monoxide among other constituents.

Downwind evacuation should be considered in some cases if this material is leaking but not on fire. If nitrobenzene is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. (Note: Nitrobenzene is of low volatility in many spill situations but is highly toxic. Judgments are necessary on a case by case basis.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.19 g/100 g water at 68°F (20°F)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and various oils.

Specific Gravity (Liquid): 1.20 at 68°F (20°F)

Boiling Point: 411.6°F (210.9°C) at 1 atm.

Melting Point: 42.3°F (5.7°C)

Freezing Point: 41.2°F (5.1°C)

Molecular Weight: 123.11

Heat of Combustion: – 5791 cal/g

Vapor Pressure: 0.30 mm Hg (0.006 psia) at 77°F (25°C)

Flash Point: 190°F (87.8°C), closed cup; 171°F (77.2°C), open cup

Autoignition Temperature: 900-924°F (482-496°C)

Burning Rate: 2.9 mm/minute

Stability: Stable

Corrosiveness: Will attack some forms of plastics, rubber and coatings.

Reactivity with Water No reaction.

Reactivity with Other Chemicals: Reacts with aluminum chloride and phenol mixture, aniline and glycerin mixture, nitric acid, nitrogen tetroxide, silver perchlorate, strong oxidizers, and caustics together with chemically active metals like tin or zinc.

IDENTIFICATION

Shipping Names: Nitrobenzene (USDOT and IMO)

Synonyms and Tradenames: Benzene, nitro; essence of mirbane; essence of myrbane; mirbane oil; nitrobenzol; oil of mirbane; oil of myrbane; oil of bitter almonds.

Chemical Formula: $C_6H_5NO_2$

Constituent Components(% each): 97-100% pure with traces of dinitrobenzene and water.

UN/NA Designation: UN1662

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Light greenish-yellow to brown; may orignally be water-white.

Odor Characteristics: Almond or bitter almond; like paste shoe polish.

Common Uses: Solvent; crude oil refining processes; mfg. of dyes, rubber chemicals, drugs, metal and shoe polishes, TNT, and a variety of other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

NITROBENZENE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Various authorities give values from 1.6 ppb to 1.9 ppm.

Unusual Hazards:: Highly toxic substance that affects the ability of the blood to carry oxygen. Effects are more dangerous than readily apparent and may be delayed up to 4 hours. Ingestion of alcohol aggravates toxic effects. Excessive heat may initiate rapid decomposition of the product with generation of additional heat.

Short Term Exposure Limits(STEL): (Skin) 2 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 1 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Excessive heat or fire; contact with incompatible materials; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazards are inhalation of vapor or ingestion of liquid. Prolonged skin contact is also to be avoided. Pregnant women may be especially at risk as may individuals with glucose-6-phosphate dehydrogenase deficiency.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with liquid nitrobenzene may cause irritation. The product can be rapidly absorbed through the skin in toxic amounts to cause cyanosis.

Hazards of Inhalation: Causes cyanosis and thereby affects the ability of the blood to carry oxygen. Symptoms include bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, unconsciousness, and possibly death if treatment is not prompt. Effects may be delayed up to 4 hours and are aggravated by ingestion of alcohol.

Hazards of Ingestion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 1.8% at 200°F (93.3°C)

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but difficult to ignite. Containers may rupture in fire due to rapid and exothermic decomposition of product above 572°F (300°C).

Hazardous Combustion Products: Nitrogen oxides, carbon monoxide and others.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture in fire. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Explosion may result if vapors from hot liquid are ignited in a confined area.

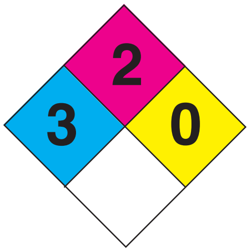
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact and any possibility of skin contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include polyvinyl alcohol, Viton, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA)with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (50 ppm or less) or an organic vapor cartridge respirator with a full facepiece (50 ppm or less) within the use limitations of these devices.

1662

NITROBENZENE
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecifc symptoms: Eye or skin irritation, symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention as necessary to cleaning hair and scalp, finger and toenails, nostrils, and ear canals.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Foam, dry chemical, carbon dioxide, water spray or fog. Water may be used to blanket fire but control any runoff.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of nitrobenzene may result in rutpure of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwide damaged by the spilled product. Take the significant toxicity of nitrobenzene into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Nitrobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of nitrobenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Nitrobenzene may expose downwind areas to toxic concentrations, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

NITROBENZENE

Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nitrobenzene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of nitrobenzene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

COVERAGE . . . The addition of water to the surface of liquid nitrobenzene may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of nitrobenzene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Nitrobenzene may be contained by building dikes or barriers using soil, sand or other materials. (Note: Nitrobenzene will freeze at low ambient temperatures.)

CONSEQUENCE

Contained nitrobenzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

NITROBENZENE
Division 6.1 (Poisonous Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

NITROBENZENE
Division 6.1 (Poisonous Material)

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

meta-NITROCHLOROBENZENE

Division 6.1 (Poisous Material)

GENERAL INFORMATION

The meta isomer of nitrochlorobenzene is a yellow solid that is likely to have a sweet aromatic odor and that may be shipped as a molten liquid (that may solidify enroute). It is used as a chemical intermediate, especially for making dyes. It is practically insoluble in water and heavier, so may be expected to sink and dissolve at an extremely slow rate. A flash point of 261°F indicates that it must be heated far above its melting point to be ignited easily. The product weighs approximately 11.2 pounds per gallon as a liquid and 95.7 pounds per cubic foot as a solid.

Meta-nitrochlorobenzene does not react with water and should be stable in normal transportation. Reactions with alkali or alkaline earth elemental metals, certain other metals, peroxides, strong oxidizing or reducing agents, caustics, or chlorine trifluoride may be explosive, and the product is otherwise reactive with a variety of other chemicals. By analogy to other isomers, some forms of plastics, rubber, and coatings may be attacked by meta-nitrochlorobenzene, but the product is not corrosive to iron or steel when dry. It is a highly toxic substance. Products of combustion may be toxic and may include nitrogen oxides, hydrogen chloride gases, carbon monoxide, chlorides, and possibly chlorine.

If meta-nitrochlorobenzene is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble.

Solubility in Other Chemicals: Soluble in acetic acid, alcohol, benzene, chloroform, ether, and most organic solvents.

Specific Gravity (Liquid): 1.343 at 122°F (50°C); 1.534 at 68°F (20°C)

Boiling Point: 455-456.8°F (235-236°C) at 1 atm.

Melting Point: 111.2-112.1°F (44-44.5°C) or 74.7°F (23.7°C) depending on form.

Freezing Point: Unavailable

Molecular Weight: 157.56

Heat of Combustion: Unavailable

Vapor Pressure: Very low

Flash Point: 261°F (127°C), closed cup.

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Assumed stable.

Corrosiveness: By analogy to other isomers, dry product is not corrosive to iron and steel but traces of moisture may cause mild corrosion of steel. May attack some forms of plastics, rubber, and coatings.

Reacativity with Water: Data unavailable, but reaction is unlikely.

Reactivity with Other Chemicals: May react with mineral acids, amines, strong oxidizing or reducing agents, alkali or alkaline earth elemental metals, certain other metals, peroxides, caustics, nitrides, cyanides, mercaptans, other organic sulfides, azo and diazo compounds, hydrazines, aldehydes, and chlorine trifluoride.

IDENTIFICATION

Shipping Names: Chloronitrobenzenes (USDOT & IMO).

Synonyms and Tradenames: Benzene, 1-chloro-3-nitro; m-chloronitrobenzene; chloro-m-nitrobenzene; 1-chloro-3-nitrobenzene.

Chemical Formula: $C_6H_4ClNO_2$

Constituent Components(% each): Almost 100% pure.

UN/NA Designation: UN1578

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Solid, or molten liquid that solidifies enroute.

Physical State as Released: Solid or molten liquid

Color of the Shipped Material: Yellow

Odor Characteristics: Unknown, assume sweet aromatic odor by analogy to other isomers; may be ammonia-like.

Common Uses: Chemical intermediate, especially for dyes.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

meta-NITROCHLOROBENZENE
Division 6.1 (Poisous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic substance that affects ability of blood to carry oxygen. Ingestion of alcohol aggravates the toxic effects of this product. Effects are more dangerous than readily apparent and may be delayed up to 4 hours.

Short Term Exposure Limits(STEL): Unavailable. See data for para isomer.

Time Weighted Average(TLV-TWA): Unavailable. See data for para isomer.

Conditions to Avoid: Heat, fire, and sparks when product is hot liquid or airborne dust; contact with incompatible materials; contamination of water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from ingestion or inhalation of vapors and dusts. Prolonged skin contact is also to be avoided.

Hazards of Skin or Eye Contact: Contact may cause allergic dermatitis but usual effect (apparently) is slight eye or skin irritation. May be absorbed through the skin rapidly in toxic amounts to cause cyanosis. Molten liquid may cause thermal burns.

Hazards of Inhalation: Causes cyanosis and affects the ability of the blood to carry oxygen. Symptoms include bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, unconsciousness, and possibly death if treatment is not prompt. Effects may be delayed up to 4 hours and are aggravated by ingestion of alcohol. Exposure to 3.3 ppm of the para isomer in air for 24 hours was fatal to cats in laboratory experiments.

Hazards of Ingestion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit. Unavailable

Upper Flammable Limit. Unavailable

Behavior in Fire: Will burn but usually difficult to ignite.

Hazardous Combustion Products: Toxic nitrogen oxides, hydrogen chloride, carbon monoxide, chlorides, and possibly chlorine.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit. Unavailable

Explosiveness: Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Vapors may form explosive mixtures in air at high temperatures.

PROTECTIVE CLOTHING AND EQUIPMENT

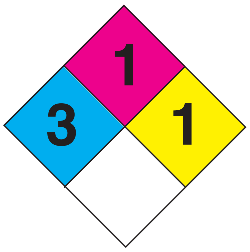
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an organic vapor canister type mask with particulate filters is recommended by a manufacturer of this isomer. See guide for para isomer for NIOSH recommendations relating to that isomer.

1578

meta-NITROCHLOROBENZENE

Division 6.1 (Poisous Material)



FIRST AID

Nonspecific Symptoms: Eye or skin irritation; symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention as necessary to cleaning hair and scalp, finger and toenails, nostrils, and ear canals.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Foam, dry chemical, carbon dioxide, water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Eliminate ignition sources as and if necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the significant toxicity of the product into account while planning the response. Note that the molten product may solidify at ambient temperatures.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Meta-nitrochlorobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of meta-nitrochlorobenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid meta-nitrochlorobenzene with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

meta-NITROCHLOROBENZENE

Division 6.1 (Poisous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapor or dusts in air or the surface of the spilled product may reduce downwind concentrations.

CONSEQUENCE

Water runoff may contain a small amount of meta-nitrochlorobenzene from contact with the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Meta-nitrochlorobenzene may be contained by building dikes or barriers using soil, sand or other materials. Liquid spills should freeze fairly rapidly under most ambient temperature conditions.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Equipment can become clogged if the product freezes.

MITIGATION

Use equipment compatible with spilled product. Act promptly and prevent freezing if possible.

TECHNIQUE

ABSORPTION . . . Spreading of liquid product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the over all volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines. Excessive agitation may cause toxic dust to become airborne.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

meta-NITROCHLOROBENZENE
Division 6.1 (Poisous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: This response included by analogy to para isomer.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

ortho-NITROCHLOROBENZENE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

The ortho isomer of nitrochlorobenzene is a yellow solid at temperatures below 90°F, has a sweet aromatic odor, and may be shipped as a molten liquid (that may solidify enroute). It is used as a chemical intermediate for making dyes, pigments, and other chemicals. It is barely soluble in water and heavier, so may be expected to sink and dissolve at an extremely slow rate. A flash point of 261°F indicates that it must be heated far above its melting point to be ignited easily. The product weighs approximately 11.4 pounds per gallon. ortho-Nitrochlorobenzene does not react with water and is stable in normal transportation. Reactions with alkali or alkaline earth elemental metals, peroxides, strong oxidizing or reducing agents, caustics, or chlorine trifluoride may be explosive, and the product is otherwise reactive with a variety of other chemicals. By analogy to other isomers, some forms of plastics, rubber, or coatings may be attacked by ortho-nitrochlorobenzene; but the product is not corrosive to iron or steel when dry. It is a highly toxic substance and is considered a poison. Products of combustion may be toxic and may include nitrogen oxides, hydrogen chloride gases, carbon monoxide, chlorides, and possibly chlorine.

If hot liquid is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.05% at 77°F (25°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene and ether.

Specific Gravity (Liquid): approx 1.37 at 72°F (22°C)

Boiling Point: 473-474.8°F (245-246°C)

Melting Point: 89.6-95°F (32-35°C)

Freezing Point: 90.5°F (32.5°C)

Molecular Weight: 157.56

Heat of Combustion: Unavailable

Vapor Pressure: 8 mm Hg (0.155 psia) at 246.2°F (119°C); very low at 68°F (20°C).

Flash Point: 261°F (127.2°C), closed cup; 264°F (128.9°C), open cup.

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Dry product is not corrosive to iron and steel but traces of moisture may cause mild corrosion of steel. By analogy to other isomers, may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: May react with mineral acids, amines, strong oxidizing or reducing agents, alkali or alkaline earth elemental metals, certain other metals, peroxides, caustics, nitrides, cyanides, mercaptans, other organic sulfides, azo and diazo compounds, hydrazines, aldehydes, and chlorine trifluoride.

IDENTIFICATION

Shipping Names: Chloronitrobenzenes (USDOT & IMO).

Synonyms and Tradenames: Benzene, 1-chloro-2-nitro; ONCB: chloro-o-nitrobenzene; o-chloronitrobenzene; 2-chloro-1-nitrobenzene; 1-chloro-2-nitrobenzene.

Chemical Formula: $C_6H_4ClNO_2$

Constituent Components(% each): 99.4% or more pure with 0.25% water max.

UN/NA Designation: UN1578

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Solid or molten liquid that solidifies enroute.

Physical State as Released: Solid or molten liquid

Color of the Shipped Material: Yellow

Odor Characteristics: Sweet aromatic nitro odor; may be ammonia-like.

Common Uses: Chemical intermediate for dyes, pigments, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

ortho-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic substance that affects ability of blood to carry oxygen. Ingestion of alcohol aggravates the toxic effects of this product. Effects are more dangerous than readily apparent and may be delayed up to 4 hours.

Short Term Exposure Limits(STEL): Unavailable. See data for para isomer.

Time Weighted Average(TLV-TWA): Unavailable. See data for para isomer.

Conditions to Avoid: Heat, fire, and sparks when product is hot liquid or airborne dust; contact with incompatible materials; contamination of water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from ingestion or inhalation of vapors and dusts. Prolonged skin contact is also to be avoided.

Hazards of Skin or Eye Contact: Contact may cause allergic dermatitis but usual effect (apparently) is slight eye or skin irritation. May be absorbed through the skin rapidly in toxic amounts to cause cyanosis. Molten liquid may cause thermal burns.

Hazards of Inhalation: Causes cyanosis and affects the ability of the blood to carry oxygen. Symptoms include bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, unconsciousness, and possibly death if treatment is not prompt. Effects may be delayed up to 4 hours and are aggravated by ingestion of alcohol. Exposure to 3.3 ppm of the para isomer in air for 24 hours was fatal to cats in laboratory experiments.

Hazards of Ingestion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Will burn but usually difficult to ignite.

Hazardous Combustion Products: Toxic nitrogen oxides, hydrogen chloride, carbon monoxide, chlorides, and possibly chlorine.

EXPLOSION HAZARDS

Lower Explosive Limit:Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Vapors may form explosive mixtures in air at high temperatures.

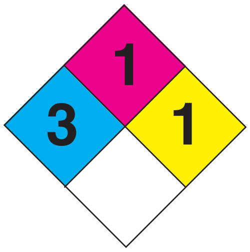
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknovm concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an organic vapor canister type mask with particulate filters is recommended by a manufacturer of this isomer. See guide for para isomer for NIOSH recommendations relating to that isomer.

1578

ortho-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Eye or skin irritation; symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention as necessary to cleaning hair and scalp, finger and toenails, nostrils, and ear canals.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Foam, dry chemical, carbon dioxide, water spray. Water or foam may cause frothing of very hot liquid.

Extinguishing Technique: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move non-leaking container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Eliminate ignition sources as and if necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the significant toxicity of the product into account while planning the response. Note that molten product will solidify at moderate ambient temperatures.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . ortho-Nitrochlorobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of ortho-nitrochlorobenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid ortho-nitrochlorobenzene witha plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

ortho-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or dusts in air or the surface of the spilled product may reduce downwind concentrations.

CONSEQUENCE

Water runoff may contain a small amount of ortho-nitrochlorobenzene from contact with the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . ortho-Nitrochlorobenzene may be contained by building dikes or barriers using soil, sand or other materials. Liquid spills should freeze fairly rapidly under most ambient temperature conditions.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Equipment can become clogged if the product freezes.

MITIGATION

Use equipment compatible with spilled product. Act promptly and prevent freezing if possible.

TECHNIQUE

ABSORPTION . . . Spreading of liquid product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines. Excessive agitation may cause toxic dust to become airborne.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

ortho-NITROCHLOROBENZENE

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: This response included by analogy to para isomer.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

para-NITROCHLOROBENZENE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

The para isomer of nitrochlorobenzene is a light yellow solid that may be shipped as a molten liquid and that has a sweet and pleasant aromatic odor. It is used for making dyes, pharmaceuticals, gasoline gum inhibitors, corrosion inhibitors, and chemicals used in agriculture, photography, and rubber production. It is practically insoluble in water and heavier, so may be expected to sink and dissolve at an extremely slow rate. A flash point of 261°F indicates that it must be heated well above its melting point to be ignited easily. The product weighs approximately 10.8 pounds per gallon.

para-Nitrochlorobenzene does not react with water and is stable in normal transportation. Reactions with alkali or alkaline earth elemental metals, certain other metals, peroxides, strong reducing agents, caustics, strong oxidizers, or chlorine trifluoride may possibly be explosive and the product is otherwise reactive with a variety of chemicals. Some forms of plastics, rubber, and coatings may be attacked by para-nitrochlorobenzene but the product is not corrosive to iron or steel when dry. It is a highly toxic substance and considered a poison. Products of combustion may be toxic and may include oxides of nitrogen, hydrogen chloride, carbon monoxide, chlorides, and possibly chlorine.

If para-nitrochlorobenzene is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.003 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, and ether.

Specific Gravity (Liquid): about 1.3 at 196°F (91°C) or 90°F (15.5°C)

Boiling Point: 462.2-467.6°F (239-242°C) at 1 atm.

Melting Point: 181.4-183.2°F (83-84°C)

Freeing Point: Unavailable

Molecular Weight: 157.56

Heat of Combustion: Unavailable

Vapor Pressure: 0.09 mm Hg (0.002 psia) at 77°F (25°C)

Flash Point: 261°F (127°C), closed cup; 255°F (124°C), open cup.

Autoignition Temperature: Unavailable

Burning Rate: Unavailable

Stability: Stable below 572°F (300°C)

Corrosiveness: Dry product is not corrosive to iron and steel but traces of moisture may cause mild corrosion of steel. May attack some forms of plastics, rubber, and coatings.

Reactivity with Water: Data unavailable, but reaction is unlikely.

Reactivity with Other Chenicals: May react with mineral acids, amines, strong oxidizing agents, alkali or alkaline earth elemental metals, certain other metals, peroxides, strong reducing agents, caustics, nitrides, cyanides, mercaptans, other organic sulfides, azo and diazo compounds, hydrazines, aldehydes, and chlorine trifluoride.

IDENTIFICATION

Shipping Names: Chloronitrobenzenes (USDOT & IMO).

Synonyms and Tradenames: Benzene, 1-chloro-4-nitro; p-chloronitrobenzene; 4-chloro-1-nitrobenzene; p-nitrochlorobenzene; 4-chloronitrobenzene; PNCB or PCNB (do not confuse with pentachloronitrobenzene).

Chemical Formula: $C_6H_4CLNO_2$

Constituent Components(% each): 99.5 + % or more pure with a trace of water.

UN/NA Designation: UN1578

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Solid, or molten liquid that solidifies enroute.

Physical State as Released: Solid or molten liquid.

Color of the Shipped Material: Light yellow

Odor Characteristics: Sweet; pleasant aromatic.

Common Uses: Mfg. of chemicals, dyes, pharamaceuticals, gasoline gum inhibitor, corrosion inhibitor, agricultural chemicals, rubber chemicals, and photographic chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

para-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic substance that affects ability of blood to carry oxygen. Ingestion of alcohol aggravates the toxic effects of exposure to this product. Effects are more dangerous than readily apparent and may be delayed up to 4 hours.

Short Term Exposure Limits(STEL): (Skin) 2 mg/m^3 for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): (Skin) 1 mg/m^3 (3 mg/m^3 proposed) over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks when product is liquid or airborne dust; contact with incompatible materials; contamination of water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from ingestion or inhalation of vapors and dusts. Prolonged skin contact is also to be avoided.

Hazards of Skin or Eye Contact: Contact may cause allergic dermatitis but usual effect (apparently) is slight eye or skin irriation. May also be absorbed through the skin rapidly in toxic amounts to cause cyanosis. Molten liquid may cause thermal burns.

Hazards of Inhalation: Causes cyanosis and affects the ability of the blood to carry oxygen. Symptoms include bluish discoloration of skin starting in lips, nose and earlobes, headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, unconsciousness, and possibly death if treatment is not prompt. Effects may be delayed up to 4 hours and are aggravated by ingestion of alcohol. Exposure to 3.3 ppm in air for 24 hours was lethal to cats in laboratory experiments.

Hazards of Ingetion: Causes cyanosis. See hazards of inhalation.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Will burn but usually difficult to ignite.

Hazardous Combusbtion Products: Oxides of nitrogen, hydrogen chloride, carbon monoxide, chlorides, and possibly chlorine.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Vapors may form explosive mixtures with air at high temperatures.

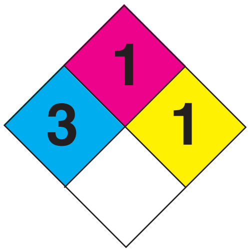
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Reguired: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency particulate filter respirator with a full facepiece (50 mg/m^3 or less); any fume respirator or dust and mist respirator except single use or quarter mask types (10 mg/m^3 or less); any dust and mist respirator of the multiple use type (5 mg/m^3 or less); within the limitations of these devices.

1578

para-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Eye or skin irritation; symptoms of cyanosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Give special attention, as necessary, to cleaning hair and scalp, finger and toenails, nostrils, and ear canals.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Foam, dry chemical, carbon dioxide, water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fume/smoke anticipated. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Eliminate ignition sources as and if necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the significant toxicity of the product into account while planning the response. Note that the molten product will solidify at ambient temperatures.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . para-Nitrochlorobenzene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of para-nitrochlorobenzene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid para-nitrochlorobenzene with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product a soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

para-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to para-nitrochlorobenzene vapors or dusts in air or the surface of the spilled product may reduce downwind concentrations.

CONSEQUENCE

Water runoff may contain a small amount of para-nitrochlorobenzene from contact with the product.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Para-nitrochlorobenzene may be contained by building dikes or barriers using soil, sand or other materials. Liquid spills should solidify fairly rapidly.

CONSEQUENCE

Contained para-nitrochlorobenzene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Equipment can become clogged if the product freezes.

MITIGATION

Use equipment compatible with spilled product. Act promptly and prevent freezing if posible.

TECHNIQUE

ABSORPTION . . . Spreading of liquid product may be controlled by absorbing liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means after product has frozen.

para-NITROCHLOROBENZENE
Division 6.1 (Poisonous Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause toxic dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Handle spilled product carefully.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. The spilled product, together with bottom material, may be deposited into a barge or pumped ashore as a slurry. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

para-NITROCHLOROBENZENE

Division 6.1 (Poisonous Material)

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

January 1990

NITROGEN
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Nitrogen is a colorless, odorless nonflammable and nontoxic element of nature that makes up about 78% of the atmosphere by volume and is handled as a compressed gas under high pressure or as a refrigerated cryogenic liquid at extremely low temperatures. Its uses include cryotherapy of skin lesions, making of various industrial chemicals and explosives, use as a coolant or propellant gas, and general use as an inert gas, among others. Due to its slight solubility in water and boiling point of approximately –320°F spills of liquid nitrogen on land or water or ruptures of compressed gas containers may quickly generate large amounts of gas that may appear white at first due to condensation of water vapor in the air. Initially, the cold gas may be heavier than air and may persist for a time in pits, hollows and depressions, but will approach the density of air as it warms. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The refrigerated liquid weighs 6.7 – 6.8 pounds per gallon at its boiling point temperature.

Due to the fact that the compressed gas is shipped at temperatures far in excess of its very low critical temperature, the pressure within containers of compressed gas is a function of the temperature of the container and the amount of nitrogen it contains (such that the term "vapor pressure" no longer has meaning). These pressures can vary, but commonly exceed 137 atmospheres (2000 psig) at room temperature within gas cylinders.

Nitrogen is fully stable in transportion and does not react with water or other common materials. It is, however, reactive with certain other rather unusual substances described below. Although nitrogen is completely nontoxic, the large volumes of gas that may be generated in a major accident may cause suffocation by displacing oxygen in the air. The extremely low temperatures that may occur under certain conditions of release (primarily but not exclusively from discharges of liquid) may cause tissue damage and burns due to frostbite.

Note: Nitrogen has two stable isotopes and four short-lived and artificial radioactive isotopes. This guide is solely intended for use with the two considerably more common non-radioactive isotopes.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 2.33–2.40 ml (gas)/100 ml water at 32°F (0°C); 1.52–1.60 ml (gas)/100 ml water at 68°F (20°C).

Solubility in Other Chemicals: Slightly soluble in alcohol; soluble in liquid ammonia and liquid oxygen.

Specific Gravity (Liquid): 0.81 at normal boiling point

Boiling Point: – 320.4 to – 319.9°F (–195.8 to – 195.5°C) at 1 atm.

Melting Point: – 346 to – 345.6°F (– 210 to – 209.8°C)

Freezing Point: See melting point

Molecular Weight: 28.01

Heat of Combustion: Not flammable

Vapor Pressure: See General Information section above.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Noncorrosive; requires no special materials of construction so long as temperatures and pressures are tolerated.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Forms cyanides when heated with carbon in the presence of alkalies or barium oxide; reacts vigorously with neodymium; may spontaneously ignite molten lithium; titanium will burn in free nitrogen at 1476°F (802°C). Overall, however, nitrogen is generally considered to be chemically unreactive.

IDENTIFICATION

Shipping Names: Nitrogen (USDOT and IMO); nitrogen, compressed (USDOT and IMO); nitrogen, refrigerated liquid (USDOT and IMO).

Synonyms and Tradenames: None, nitrogen is one of the natural elements.

Chemical Formula: N_2

Constituent Components (% each): 99.5% or more pure with possible traces of nitrogen oxides, methane, oxygen, and possibly other gases.

49 STCC: 49 045 65 (nitrogen or compressed nitrogen); 49 045 66 (refrigerated liquid).

UN/NA Designation: UN1066 (nitrogen or compressed nitrogen); UN1977 (refrigerated liquid).

IMO Designation: 2.2, nonflammable gas

Physical State As Shipped: Compressed gas or refrigerated liquid

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless to faint yellow liquid; colorless gas

Odor Characteristics: Odorless

Common Uses: Cryotherapy of skin lesions; making of various industrial chemicals and explosives; as a coolant or propellant gas; in food freezing operations; for filling certain thermometers and incandescent light bulbs; as a general inert gas; and for bright annealing of steel.

NITROGEN
Division 2.2 (Nonflammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Large volumes of nontoxic and nonflammable gas generated upon release may cause suffocation via displacement of oxygen in air at high concentrations. Extreme cold of liquid or vapors may cause tissue damage or burns due to frostbite. Temperatures may be low enough under some conditions to condense and liquefy some amount of oxygen from air on the surface of equipment containing liquid nitrogen. Very cold nitrogen gas is heavier than air and may persist for a time in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): Unavailable; see below

Time Weighted Average (TLV-TWA): Unavailable; listed as simple asphyxiant.

Conditions to Avoid: Entry into any area in which oxygen levels may be reduced unless a self-contained breathing apparatus is worn. Contact with cold liquid, gas, or containment equipment. Use of equipment not suitable for the temperatures and pressures that may be encountered.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the high gas concentrations that may be present in air in the immediate spill area. Contact should be avoided with cold liquid, gas, or containment equipment to prevent tissue damage and burns due to frostbite.

Hazards of Skin or Eye Contact: Contact with liquid nitrogen or cold nitrogen gas may cause extensive tissue damage or burns due to the extremely cold temperatures involved. Blistering and deep tissue freezing may occur from excessive contact.

Hazards of Inhalation: High concentrations of nitrogen gas in air may cause suffocation by diluting the concentration of oxygen in air below levels necessary to support life. Lack of oxygen may produce dizziness, nausea, errors in judgment, fatigue, accelerated pulse, gasping, confusion, vomiting, headache, loss of consciousness and death, possibly in seconds and without warning. Dangers increase as oxygen concentrations drop below 18 percent by volume in air.

Hazards of Ingestion: Ingestion of liquid nitrogen is highly unlikely.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable compressed gas or refrigerated liquid. Containers may rupture violently in fire due to overpressurization. Will generate large quantities of nontoxic and nonflammable gas upon release.

Hazardous Combustion Products: *Will* not burn or decompose but forms cyanides when heated with carbon in the presence of alkalies or barium oxide.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Not flammable but containers may rupture violently in fire due to overpressurization.

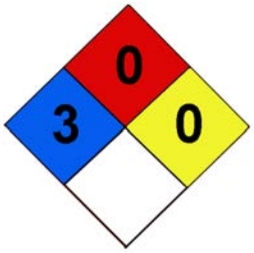
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with excessively cold liquid nitrogen, gas, or containment equipment. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Note that gas masks and cartridge type respirators will not function in oxygen depleted environments and may lead to suffocation.

1066

NITROGEN
Division 2.2 (Nonflammable Gas)



FIRST AID

Nonspecific Symptoms: Symptoms of oxygen deficiency or frostbite.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration and get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove frozen clothing after thawing. Wash affected body areas with large amounts of water. Get medical attention immediately. Do not use hot water on or rub frostbitten areas.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid bodily contact with cold liquid or gas. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential due to overpressurization. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent entrapment of liquid in closed systems. Use oxygen monitoring equipment to test for oxygen deficient atmospheres where necessary. Vent nitrogen to atmosphere slowly in well ventilated outdoor location if this method of disposal is selected. Note that cold liquid nitrogen in exposed piping may cause some amount of oxygen in air to condense and liquefy. Consequently, it is best that any insulating materials used be compatible with oxygen if possible. Only metals and materials compatible with extremely low temperatures and/or high pressures should be used, thus excluding use of metals or other materials that may become brittle at the low temperatures that may be encountered. Take the initially heavier than air nature of nitrogen gas into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Nitrogen discharges may not generate hazardous airborne contaminant concentrations over significant distances in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the product is removed or depleted, particularly if less than large amounts have been released in outdoor locations.

CONSEQUENCE

Hazardous levels of nitrogen in air may be found in the local spill area and immediately downwind.

MITIGATION

Restrict access to the local spill area and areas immediately downwind by unprotected personnel until flow is stopped or the container empties. Check for oxygen levels in air.

TECHNIQUE

EVACUATION . . . Where necessary due to the possibility of massive releases in populated areas, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

NITROGEN
Division 2.2 (Nonflammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid nitrogen, where necessary due to vulnerable surroundings, may be contained by building dikes or barriers using soil, sand or other materials. Note that any spilled liquid will boil vigorously at first and continue to vaporize rapidly.

TECHNIQUE

EXCAVATION . . . Where necessary, a trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Where necessary and possible, accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks due to the high pressures and low temperatures that may be encountered.

MITIGATION

Use suitable equipment. Consider allowing liquid nitrogen to boil or evaporate until naturally depleted or use a light water spray to accelerate boil-off.

WATER SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Any liquid nitrogen contacting a water body will rapidly boil off. Traces of nitrogen remaining in the water (if any) are completely harmless.

January 1995

NITROGEN TETROXIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Nitrogen tetroxide, also commonly referred to as nitrogen dioxide, is a yellowish to dark brown, nonflammable, highly volatile and extremly poisonous liquid with a boiling point in the range of 69.5 to 70.3°F and a freezing point variously reported to be either 11.8 or 15.3°F. The solid product is colorless. Vapors and fumes evolving from the liquid are reported to be yellowish-brown, reddish-brown, or dark brown when in sufficient concentrations to be visible in air. They have a sharp, pungent, acrid, unpleasant and irritating odor. The product is used for making nitric and sulfuric acids as well as nitrated organic chemicals and explosives. It is also used as a catalyst, an oxidizer for rocket fuels and other substances, a polymerization inhibitor for acrylates, and as an agent for increasing the wet strength of paper.

Nitrogen tetroxide (N_2O_4)and nitrogen dioxide (NO_2) are usually found together in equilibrium. Each molecule of nitrogen tetroxide actually consists of two molecules of nitrogen dioxide which have combined. These molecules may also break apart to reform nitrogen dioxide. Solid nitrogen tetroxide is essentially pure N_2O_4. At a temperature of 212°F the liquid contains less than 1%, nitrogen dioxide but the vapor contains about 90%, of the latter substance. Liquid nitrogen tetroxide and nitrogen dioxide are soluble in water and heavier and will react to form nitric and nitrous acids. It is not clear whether the reaction is violent, but a lack of readily available information on the subject implies it is not.

The vapors and fumes of the product are heavier than air and may persist in pits, hollows, and depressions. Some cylinders and other containers used in transportation are not equipped with safety pressure relief devices and are particularly at risk to rupture violently due to overpressurization and possibly rocket if exposed to fire or excessive heat, thus suddenly releasing large amounts of vapors and fumes into the atmosphere. This hazard is shared with all other containers used to transport or store the product, but to a somewhat lesser degree.

Although nitrogen tetroxide and nitrogen dioxide are not themselves combustible, they are extremely reactive oxidizers that may cause a fire or explosion upon contact with combustible or oxidizable materials and will support and accelerate their burning. The products are not corrosive to most structural materials when dry. In the presence of moisture, however, the formation of acids may develop corrosive conditions. Both nitrogen oxides of concern are extremely toxic and dangerous via all routes of exposure but especially if inhaled in even relatively low concentrations in air. Liquid nitrogen tetroxide and nitrogen dioxide weigh approximately 12.1 pounds per gallon at room temperature.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, and weather conditions if nitrogen tetroxide is leaking from its container. A large release may require an evacuation or protective action zone measured in miles. Evacuation may also become necessary if a container is exposed to direct flame or a fire becomes uncontrollable, not only for protection from flying debris if the container should rupture violently, but also because a large amount of non-flammable but extremely toxic vapors and fumes may be suddenly released to the atmosphere.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble; reacts to form nitric acid, nitrous acid, and nitric oxide.

Solubility in Other Chemicals: Reported to be soluble in alkalies, carbon disulfide, chloroform, and concentrated sulfuric and nitric acids.

Specific Gravity (Liquid): 1.45 at 68°F (20°C)

Boiling Point: 69.5-70.3°F (20.8-21.3 °C) at 1 atm.

Melting Point: 11.8 or 15.3°F (–11.2 or – 9.3°C); reported values vary

Freezing Point: See melting point

Molecular Weight: 92.02 for nitrogen tetroxide (N_2O_4); 46.01 for nitrogen dioxide (NO_2)

Heat of Combustion: Not flammable

Vapor Pressure: 400 mm Hg (7.732 psia) at 46.4°F (8°C); approx 720 mm Hg (13.917 psia) at 68°F (20^{o}C); 1782 mm Hg (34.44 psia) at 105°F (40.6°C)

Flash Point: Not flammable

Stability: Stable in normal transportation when sealed in gas-tight container.

Corrosiveness: Not corrosive to mild steel at ordinary temperatures and pressures when dry (0.1% moisture or less); numerous metals and alloys such as carbon steel, stainless steel, aluminum, nickel and Inconel are satisfactory for handling and storage.

Reactivity with Water: Forms nitric and nitrous acids. the latter decomposing, especially with increased temperature, to nitric acid and nitric oxide. Nitric oxide may react with oxygen to form more nitrogen dioxide.

Reactivity with Other Chemicals: N_2O_4 and NO_2 are strong oxidizing agents with the potential to react violently with, cause the ignition of, or explode in contact with combustible and/or oxidizable materials.

IDENTIFICATION

Shipping Names: Dinitrogen tetroxide (USDOT and IMO); nitrogen dioxide (IMO)

Synonyms and Tradenames: Nitrogen (IV) oxide; dinitrogen tetroxide; NTO; red oxide of nitrogen; nitrito

Chemical Formula: N_2O_4 for nitrogen tetroxide; NO_2 for nitrogen dioxide

Constituent Components (%, each): 99.5%, or more pure mixture; the product exists as an equilibrium mixture of NO_2 and N_2O_4. At 212°F (100°C), the liquid state contains less than 1 percent NO_2 and the vapor state contains about 90% NO_2. The solid form is entirely N_2O_4. Nitrogen tetroxide may also be shipped as a mixture with nitric oxide. Nitric oxide combines with oxygen in the air upon release to form nitrogen dioxide, with the rate of conversion depending on several factors. Nitric oxide and nitrogen dioxide are often found together in air in dynamic equilibrium.

UN/NA Designation: UN1067 (dinitrogen tetroxide); UN1975 (nitric oxide and nitrogen tetroxide mixtures.)

IMO Designation: 2.3, poison gas

Physical State As Shipped: Solid, liquid, or compressed liquefied gas

Physical State As Released: Gas, mixture of gas and aerosols (small liquid droplets, fuming and/or boiling liquid, or solid depending upon environmental and release conditions; the product boils at about 70°F and solidifies at about 15°F or below.

Color of the Shipped Material: Colorless solid; yellowish to dark brown liquid; vapors are variously reported to be yellowish-brown, reddishbrown, or dark brown when in sufficient concentration to be visible in air.

Odor Characteristics: Sharp, pungent, unpleasant, acrid, irritating.

Common Uses: Making nitric and sulfuric acids; nitration of organic compounds and explosives; catalyst; oxidizer for rocket fuels and other substances.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

NITROGEN TETROXIDE

Division 2.3 (Poison Gas)

Square background applies to rail cards.
See "UN/NA Designation"
for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reported data vary; one source states that the odor of NO_2 is perceptible to some people at 0.11 ppm and for most at 0.22 ppm. Others list an odor threshold of 5 ppm.

Unusual Hazards: Highly volatile substance with extremely toxic vapors that may be dangerous over very considerable downwind distances depending on location, rate and duration of release, and weather conditions. Lethal doses may be inhaled before a victim experiences any significant discomfort. A highly reactive and strong oxidizing agent. Vapors are heavier than air and may persist in low areas.

Short Term Exposure Limits (STEL): 5 ppm as NO_2 for 15 minutes (ACGIH, 1990 – 91); 1 ppm for 15 minutes as NO_2 (OSHA, 1989)

Time Weighted Average (TWA) Limits: 3 ppm as NO_2 over each 8 hours of a 40 hour work week (ACGIH TLV, 1990 – 91): OSHA permitted a transitional ceiling limit for NO_2 of 5 ppm in 1989 which will be phased out over time in favor of the 1 ppm STEL reported above.

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: One of the most insidious and dangerous substances with respect to vapor inhalation hazards. Significant discharges may be highly hazardous at the spill site and over considerable distances downwind. Direct contact with both the liquid and its vapors and fumes should be strictly avoided. Note that the following discussions are somewhat generalized in order to address the mixture of nitrogen oxides that may be present in air following a discharge of nitrogen tetroxide.

Hazards of Skin or Eye Contact: The vapors and fumes of concern may be extremely irritating to the eyes, nose, throat, and skin. Excessive contact with the skin may result in burns. Contact with the eyes may cause severe irritation or possibly permanent injury involving marked redness, swelling, and opacification of the cornea; only 70 ppm of nitrogen tetroxide vapors in air for 8 hours were required to cause persistent corneal opacification in the eyes of rabbits that survived the experiment; higher concentrations may possibly cause this effect in far less time. Contact of liquid nitrogen tetroxide with the skin or eyes will cause severe burns upon even brief contact. Permanent eye injury may result. Prolonged or widespread contact with either vapor or liquid may result in the absorption of potentially harmful amounts of these substances through the skin. Contact with ordinary clothing may cause its ignition. Contact lenses should not be worn when working with this substance.

Hazards of Inhalation: Depending on the level and duration of exposure, these gases and vapors may cause different responses in victims. At high levels in air, symptoms potentially include irritation of the eyes, nose and throat, drowsiness, dizziness, headache, tightness and/or burning in the chest, coughing, choking, production of frothy or mucoid sputum, salivation, restlessness, anxiety, mental confusion, nausea, vomiting, tremors, incoordination, cyanosis, fatigue, increasing and/or irregular respiratory and heart rates, difficulty in breathing, and lung airway constriction resulting in asphyxiation, convulsions, coma and possibly rapid death. Substantially lower concentrations can result in delayed pulmonary edema and death, often with little or no initial symptoms or warning signs. For example, breathing as little as 25 ppm of nitrogen oxides for 8 hours, 100 to 150 ppm for 30 to 60 minutes or just a few breaths at 200 to 700 ppm, may cause severe effects after a latent period of as little as 2 hours, 5 to 8 hours (apparently most typical), or as long as 48 hours in which there are few significant symptoms (if any) and the victim may feel well. The respiratory system effects discussed above will suddenly appear after this period and may ultimately cause death. In yet other cases, there may be mild or moderate signs of injury immediately after the exposure. These will disappear over a period of 2 to 3 weeks, only to be followed by sudden onset of fever, chills, increasing difficultly in breathing, increasing cyanosis, pulmonary edema, and possibly death. Survivors usually recover in another 2 to 3 weeks; however, some do not return to normal but experience varying degrees of impaired lung function. Pneumonia is a general threat from all major exposures. Other significant observations are that: 1) NO_2 exposures may decrease resistance to pulmonary infection; 2) severity of the pulmonary reaction may be lessened if the victim avoids exertion after exposure; 3) just a few ppm in air (e.g., 4-5 ppm of NO_2 for 15 minutes) may rapidly cause increased resistance to the flow of air and other effects in the respiratory systems of healthy adults; 4) inhalation of nitrogen oxides at very low concentrations (e.g., 0.1 ppm of NO_2 for 2 hours) may aggravate the conditions of people with “reactive airway disease”, including those who suffer from asthma, chronic bronchitis, or inflammatory or fibrotic pulmonary disease; and 7) survivors of significant exposures may occasionally develop “bronchiolitis fibrosa obliterans” fibrotic lesions in the lungs) between 10 days to 6 weeks after resolution of acute symptoms.

Hazards of Ingestion: Ingestion is deemed by most authorities to be an unlikely source of exposure and rarely discussed in the literature. One manufacturer simply states that ingestion may result in burns of the mouth, esophagus, and stomach. It is not unreasonable to assume that far more serious effects may follow and that death may result if the exposure is severe.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable substance that is a strong oxidizer and may support and possibly greatly intensify surrounding fires upon release. There is a possibility that some substances that do not normally burn in air will ignite or explode upon contact with the liquid or in a highly oxidizer enriched atmosphere. Containers may rupture violently and possibly rocket in a fire, suddenly releasing large quantities of extremely toxic oxidizing gases into the atmosphere.

Hazardous Combustion Products: Not flammable

1067

See "UN/NA Designation"
for other ID numbers.

NITROGEN TETROXIDE

Division 2.3 (Poison Gas)

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may rupture violently in a fire and possibly rocket. Cylinders and “ton container” tank cars may not be equipped with safety pressure relief devices and are particularly at risk. The substance is a strong oxidizer that may cause a wide variety of materials to ignite or explode upon contact.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with nitrogen tetroxide or nitrogen dioxide. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing for normal working conditions. Several authorities strongly recommend the use of fully encapsulating suits with self-contained breathing apparatus (SCBA) to prevent contact with the liquid or its concentrated vapors in the event of a discharge. Compatible materials for nitrogen tetroxide and nitrogen dioxide may include chlorinated polyethylene, polyethylene, chlorobutyl rubber, and CR 39.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister (5 ppm or less) containing non-oxidizable sorbents and providing protection against nitrogen dioxide or a chemical cartridge respirator (5 ppm or less) with a full facepiece and cartridge(s) containing non-oxidizable sorbents and providing protection against nitrogen dioxide within the use limitations of these devices. N_20_4 and NO_2 are strong oxidizers and should not come in contact with oxidizable materials. Some cartridges and canisters may contain oxidizable materials, such as activated charcoal or carbon, and therefore should not be used to provide protection against these substances.

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, nose, throat, or skin; other symptoms of exposure to the nitrogen oxides of concern.

First Aid for Inhalation: Anyone exposed even momentarily to high concentrations of nitrogen oxides in air should receive immediate attention. Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim’s lungs or vomit.) Get medical attention immediately. Qualified personnel should administer oxygen as soon as possible to prevent or minimize the possibility of pulmonary edema. Keep the victim warm, quiet, and under medical observation until the danger of delayed pulmonary edema has passed (at least 72 hours). Physical exertion should be discouraged as it may increase the severity of resulting pulmonary edema or chemical pneumonitis. Note that there are specific medical treatments recommended for exposure to these substances.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelid. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention immediately. (Note: These recommendations apply to both the liquid contaminant and its vapor or fumes in air. Be advised that certain types of clothing may ignite at some point after contamination.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have the victim lean forward to reduce the risk of aspiration of liquid into the lungs.

FIRE RESPONSE

Extinguishing Materials: Authorities disagree. The USDOT (1990) recommends that only water spray or fog be used on small fires or where a fire must otherwise be fought. It specifically says not to apply dry chemical, carbon dioxide or Halon, but its rationale for avoiding all alternatives is unclear. Others recommend use of water, foam, carbon dioxide, or dry chemical on surrounding fires as necessary. It would appear best to follow USDOT recommendations or to use other extinguishing agents with due caution. In particular, note that certain Halons have the potential to react violently with the nitrogen oxides of concern.

Extinguishing Techniques: Unusual toxic gas, corrosive fume, and oxidizing agent hazard. Keep combustible and oxidizable materials away from spilled material. Stop leak if you can do it without risk. Stay upwind. Wear breathing apparatus and appropriate protective clothing, including fully-encapsulating vapor-protective suit where contact with material or its vapors or fumes is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may rupture violently, possibly rocket, and suddenly release massive amounts of product when exposed to high heat. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

NITROGEN TETROXIDE

Division 2.3 (Poison Gas)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area and out of low areas. Avoid all contact with discharged product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Since reverse flow into a cylinder may cause rupture, use a check valve or other protective device in any line or piping from a cylinder to prevent reverse flow. Take the extremely toxic and reactive nature of the nitrogen oxides of concern into account when planning the response. Note also that nitrogen tetroxide freezes at either 11.8 or 15.3F. Cooling of the liquid below its freezing point will solidify the product and may provide a useful means to stop or reduce the flow of liquids from holes or cracks in containers and/or to facilitate containment and cleanup.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Nitrogen tetroxide or nitrogen dioxide discharges may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to the nitrogen oxides of concern in air may absorb vapors and fumes and accelerate their dispersal in the atmosphere. (Note: The reaction between water and liquid nitrogen tetroxide or nitrogen dioxide is not reported as being violent. Nevertheless, if it appears that contact of water with these liquids is increasing evolution of vapors or fumes, apply water at a point downwind and away from liquid pools.)

CONSEQUENCE

Water runoff may contain corrosive nitric and nitrous acids from contact with airborne vapors and fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . There is an unconfirmed possibility that the addition of a relatively large amount of water to contained liquid nitrogen tetroxide or nitrogen dioxide may slow the release of vapors into the atmosphere. (Note: The reaction between water and liquid nitrogen tetroxide or nitrogen dioxide is not reported as being violent. Nevertheless, if it appears that contact of water with these liquids is increasing evolution of vapors or fumes or shows signs of violence, immediately terminate this response technique unless the spill quantity is relatively small and large amounts of water can be rapidly applied on a sustained basis. Proceed with extreme caution at first.)

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

NITROGEN TETROXIDE
Division 2.3 (Poison Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid nitrogen tetroxide, nitrogen dioxide, and contaminated water runoff may be contained by building dikes using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of these liquids and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain liquid leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Higher than ambient pressures may develop in equipment at higher than moderate temperatures.

MITIGATION

Use equipment of proper pressure capacity that is compatible with the spilled product and any acids that may be formed in contact with moisture or water. Consider using a cold gas such as nitrogen to precool transfer lines and receiving containers when necessary to avoid high initial vaporization rates of the product upon its entry into equipment warmer than its boiling point.

TECHNIQUE

ABSORPTION . . . Where temperatures permit, spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, compatible commercial sorbents and other compatible substances according to various authorities. Note that a 1981 publication of the EPA only lists calcium carbonate as a suitable sorbent material. Note also that the boiling point of nitrogen tetroxide and nitrogen dioxide is approximately 70°F and that the liquid product will boil or otherwise vaporize rapidly under most ambient temperature conditions. This technique is most appropriate in cold weather and/or where sorbents can quickly and safely be placed in appropriately sealed and compatible containers.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under the guidance of a qualified expert. Note that noncombustible sorbents should be used in order to reduce the risk of fire.

NITROGEN TETROXIDE

Division 2.3 (Poison Gas)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical neutralization agents may entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Solid nitrogen tetroxide, contaminated soil and/or liquid residues may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Certain oxidizable substances that have been exposed to the nitrogen oxides and acids of concern may possibly be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product and any nitric and nitrous acids which may form in the presence of moisture or water. Store contaminated materials in a safe and secure location. Do not operate motorized equipment where their use may lead to ignition of combustible materials. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Liquid or solid nitrogen tetroxide and nitrogen dioxide are heavier than water and will sink and react to form nitric acid, nitrous acid and nitric oxide, the latter of which will combine with oxygen to form more nitrogen dioxide. The rate at which these reactions will take place could not be readily determined but is assumed sufficient in most cases to preclude the use of pumps and hoses to remove pools of the liquid products of concern from the bottom of the water body. There may be cases, however, in which containment and pumping from the bottom may be viable options.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Contaminated water may be contained (or diverted to an impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: One authority reports that anion exchange resins may also be effective.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 1992

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Pure nitrogen trioxide has a normal boiling point of 38.3°F (3.5°C) and is usually shipped as a non-combustible, poisonous, compressed liquefied gas in steel cylinders, though the use of larger containers is not prohibited if appropriate transportation regulations are satisfied. When pure, the product is a blue liquid or light bluish gas with an unpleasant odor. Liquid nitrogen trioxide weighs approximately 12.1 pounds per gallon near its boiling point temperature. NOTE WELL: Due to the complex phenomena that take place wen nitrogen trioxide is exposed to air or moisture, it is advised that the Emergency Action Guides for Nitric Acid, Nitric Oxide, and Nitrogen Tetroxide be used in conjunction with this Guide at the scene of an emergency.

Liquid nitrogen trioxide (N_2O_3) may contain some amounts of nitric oxide (NO) and nitrogen dioxide (NO_2) due to its partial dissociation in the liquid state. When released into air, nitrogen trioxide vapors are mostly dissociated into nitric oxide and nitrogen dioxide, the latter of which will form and be in equilibrium with various amounts of nitrogen tetroxide (N_2O_4). The presence of moisture may resut in formation of some amounts of corrosive nitric and nitrous acids. See the "Stability" and "Reactivity with Water" discussions below for further details. As these processes occur, the mixture of gases, vapors, and fumes that form in air may appear yellowish-brown, reddish-brown, or dark brown if present in sufficient concentrations. The odor of mixture components has variably been described as sharp, sweet, acrid, unpleasant, pungent, and irritating. Although nitric oxide is practically insoluble in water, nitrogen trioxide and the oter nitrogen oxides and acids formed are considerably more soluble.

The gases, vapors, and fumes of concern are heavier than air and may persist in low areas. Cylinders and other containers used to transport nitrogen trioxide are not usually equipped with safety pressure relief devices and are particularly at risk to rupture violently if exposed to fire or excessive heat for sufficient time duration, thus suddenly releasing large amounts of gases, vapors and fumes into the atmosphere. Nitrogen trioxide and the other nitrogen oxides mentioned are extremely reactive oxidizers that support and accelerate combustion and which may cause a fire or explosion upon contact with numerous combustible or oxidizable materials. All of these nitrogen oxides are extremely toxic and dangerous via all routes of exposure but especially if inhaled.

Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, and weather conditions if nitrogen trioxide is leaking from its container. A large release may require a very large evacuation or protective action zone. Evacuation may also become necessary if a container is exposed to direct flame or a fire becomes uncontrollable, not only for protection from flying debris if the container should rupture violently, but also because a large amount of noncombustible but extremely toxic gases, vapors and fumes may suddenly be released into the atmosphere.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reported as soluble in cold water.
Solubility in Other Chemicals: Soluble in ether
Specific Gravity (Liquid): 1.447 at 35.6°F (2°C)
Boiling Point: 38.3°F (3.5°C) at 1 atm.
Melting Point: –151.6°F (–102°C)
Freezing Point: See melting point
Molecular Weight: 76.02
Heat of Combustion: Not combustible
Vapor Pressure: 21.4 atm (314.7 psia) at 70°F (21.1°C)
Flash Point: Not combustible
Autoignition Temperature: Not combustible
Burning Rate: Not combustible

Stability: Liquid nitrogen trioxide may contain some amounts of nitric oxide and nitrogen dioxide due to partial dissociation. In the gaseous state at room temperatures, nitrogen trioxide is largely dissociated into nitric oxide and nitrogen dioxide, the latter of which will form and be in equilibrium with various amounts of nitrogen tetroxide. Overall, at a temperature of 77°F (25°C), the combination of these gases in air will only contain about 10% nitrogen trioxide b volume. At temperatures below 70°F (21.1°C), some nitrogen oxide and/or nitrogen tetroxide gas in air may condense to form liquid nitrogen tetroxide.

Corrosiveness: Nitrogen trioxide is corrosive to steel in the presence of moisture or water. However, if its moisture content is 0.1% or less, steel is a satisfactory container material.

Corrosiveness (continued): Either wet or dry nitrogen trioxide may be handled in type 18 – 8 stainless steel. At least one producer of the product uses type 303 stainless steel in valves in contact with dry nitrogen trioxide liquid. It is expected that the product will attack some forms of plastics, rubber, and coatings. See the Guides for nitric oxide, nitrogen tetroxide, and nitric acid for additional corrosivity data.

Reactivity with Water: Through various means, it may be expected that corrosive nitric and nitrous acids will form when the various nitrogen oxides of interest encounter moisture or water. Nitric acid has the chemical formula HNO_3; the chemical formula for nitrous acid is HNO_2.

Reactivity with Other Chemicals: Little specific information is available for nitrogen trioxide itself beyond the report that phosphine gas ignites spontaneously if a trace of nitrogen trioxide is added. Nitric oxide, nitrogen dioxide, and nitrogen tetroxide are all very strong oxidizing agents with the potential to react violently with, cause the ignition of, or explode in contact with numerous other chemicals and combustible and/or oxidizable materials. Decomposition of the dioxide and tetroxide at elevated temperatures will release oxygen that supports and accelerates combustion. Seek additional information from quailfied experts on the interaction of the products in question with specific substances where necessary. Space does not permit a full discussion of all known incompatible materials.

IDENTIFICATION

Shipping Names: Nitrogen trioxide
Synonyms and Tradenames: Dinitrogen trioxide; nitrogen (III) oxide; nitrogen sesquioxide; and nitrous anhydride
Chemical Formulae: N_2O_3 for nitrogen trioxide; NO for nitric oxide; NO_2 for nitrogen dioxide; N_2O_4 for nitrogen tetroxide
Constituent Components (% each): May be 99% or more pure when first produced but the liquid may partially dissociate thereafter. See the Stability discussion above.
49 STCC: 49 203 74 for nitrogen trioxide
UN/NA Designation: UN2421
IMO Designation: 2.3, poison gas
Physical State As Shipped: Compressed liquefied gas (boils at 38.3°F)
Physical State As Released: Gas, mixture of gas and aerosols (small liquid droplets), or boiling liquid. Note that any nitrogen tetroxide formed in air may condense to form liquid
Physical State As Released (continued): droplets or fumes at temperatures of 70°F and below and that nitrogen tetroxide solidifies at temperatures of about 15°F and below.
Color of the Shipped Material: Nitrogen trioxide is a blue liquid or solid and a light bluish gas when pure. As it dissociates in air, the mixture of nitrogen oxides that forms may appear yellowish-brown, reddish-brown, or dark brown if present in sufficient concentrations.
Odor Characteristics: Nitrogen trioxide is simply reported to have an unpleasant chemical odor. The odor of nitric oxide gas has variably been described as sharp, sweet, acrid, unpleasant, pungent, and irritating. Nitrogen tetroxide's odor is said to be similar to that of nitric odor.
Common Uses: Used as an oxidizer in special fuel systems, to make pure alkali nitrites, and for identification of terpenes.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

Square background
applicable to rail cars.

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: No specific data are available for nitrogen trioxide. Reported data vary for nitrogen dioxide. One source reports that the odor of NO_2 is perceptible to some people at 0.11 ppm and for most at 0.22 ppm; others list its odor threshold as 5 ppm.

Unusual Hazards: *Will* evolve extremely toxic gases, vapors, and fumes that may be dangerous over very considerable downwind distances depending on location, rate and duration of release, as well as weather conditions. Lethal doses of these materials may be inhaled before a victim experiences any significant discomfort. The substances of concern are highly reactive and strong oxidizing agents. They are heavier than air and may persist in low areas. Containers do not usually have pressure relief devices and are prone to rupture violently in a fire or if exposed to excessive heat for sufficient time duration.

Short Term Exposure Limits (STEL): Not established for nitrogen trioxide; 5 ppm as NO_2 for 15 minutes (ACGIH, 1991–92); 1 ppm for 15 minutes as NO_2 (OSHA, 1989).

Time Weighted Average (TWA) Limits: Not established for nitrogen trioxide; 25 ppm as nitric oxide or 3 ppm as NO_2 over each 8 hours of a 40 hour work week (ACGIH TLV, 1991–92); 25 ppm as nitric oxide (OSHA PEL, 1989) under similar circumstances.
OSHA permitted a transitional ceiling limit for NO_2 of 5 ppm in 1989 which will be phased out over time in favor of the STEL reported above. Note that use of exposure limits is a complex undertaking where a mixture of highly toxic and related gases may be present in air.

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of even low concentrations of nitrogen trioxide and the substances it forms in air, these being among the most insidious and dangerous substances in commerce with respect to this hazard. Significant discharges may be highly dangerous at the spill site and over considerable downwind distances. Direct contact with gas, fumes or liquid with the skin and particularly the eyes should also be strictly avoided. Note that the following discussions are generalized in order to address the mixture of nitrogen oxides that may be present in air following a discharge of nitrogen trioxide.

Hazards of Skin or Eye Contact: The gases, vapors, and fumes of concern can be extremely irritating to the eyes, nose, throat, and skin. Excessive contact with the skin may result in burns. Contact with the eyes may cause severe irritation or possibly permanent injury involving marked redness, swelling, and opacification of the cornea. Only 8 hours exposure to 70 ppm of nitrogen tetroxide vapors in air were required to cause persistent corneal opacification in the eyes of rabbits that survived the experiment; higher concentrations may possibly cause this effect in far less time. Contact of liquid nitrogen trioxide with the skin, by analogy to the characteristics of nitrogen tetroxide, may be expected to cause severe burns upon even brief contact; contact with the eyes may result in permanent eye injury. Due to its boiling point temperature, frostbite due to contact with liquid nitrogen trioxide, very cold gas streams, or very cold containers is of additional concern. Prolonged or widespread contact with either gases vapors, fumes, or liquids may result in the absorption of potentially harmful amounts of these substances through the skin. Ordinary clothing may be ignited when contaminated by these substances. Do not wear contact lenses where these substances have been or may be discharged.

Hazards of Inhalation: Depending on the level and duration of exposure, these gases and vapors may cause different responses in victims. At high levels in air, symptoms potentially include irritation of the eyes, nose and throat, drowsiness, dizziness, headache, tightness and/or burning in the chest coughing, choking, production of frothy or mucoid sputum, salivation, restlessness, anxiety, mental confusion, nausea, vomiting, tremors, incoordination, cyanosis, fatigue, increasing and/or irregular respiratory and heart rates, difficulty in breathing, and lung airway constriction resulting in asphyxiation, convulsions, coma and possibly rapid death. For example, exposure of mice to 5000 ppm of nitric oxide for 6 to 8 minutes was fatal, as was exposure to 2500 ppm for 12 minutes. Cyanosis occurred after a few minutes; breathlessness, paralysis, convulsions and death followed. Substantially lower concentrations can result in delayed pulmonary edema and death, often with little or no initial symptoms or warning signs. For example breathing as little as 25 ppm of nitrogen oxides for 8 hours, 100 to 150 ppm for 30 to 60 minutes, or just a few breaths at 200 to 700 ppm, may cause severe effects after a latent period of as little as 2 hours, 5 to 8 hours (apparently most typical), or as long as 48 hours in which there are few significant symptoms (if any) and the victim may feel well. The respiratory system effects discussed above will suddenly appear after this period and may ultimately cause death. In yet other cases, there may be mild or moderate signs of injury immediately after the exposure. These will disappear over a period of 2 to 3 weeks, only to be followed by sudden onset of fever, chills, increasing difficultly in breathing, increasing cyanosis, pulmonary edema, and possibly death. Survivors usually recover in another 2 to 3 weeks however, some do not return to normal but experience varying degrees of impaired lung function. Pneumonia is a general threat from all major exposures. Other significant observations are that: 1) NO_2; exposures may decrease resistance to pulmonary infection; 2) severity of the pulmonary reaction may be lessened if the victim avoids exertion after exposure; 3) just a few ppm in air (e.g., 4–5 ppm of NO_2 for 15 minutes) may rapidly cause increased resistance to the flow of air and other effects in the respiratory systems of healthy adults; 4) inhalation of nitrogen oxides at very low concentrations (e.g., 0.1 ppm of $N0_2$ for 2 hours) may aggravate the conditions of people with "reactive airway disease", including those who suffer from asthma, chronic bronchitis, or inflammatory or fibrotic pulmonary disease; and 7) survivors of significant exposures may occasionally develop "bronchiolitis fibrosa obliterans" (fibrotic lesions in the lungs) between 10 days to 6 weeks after resolution of acute symptoms.

Hazards of Ingestion: Due to characteristics of the substance, ingestion of liquid nitrogen trioxide is considered unlikely. Its effects via single oral doses have apparently not been studied. Nevertheless, it may be presumed that frostbite and burns may take place upon contact with bodily tissues and that toxicological effects may be severe and possibly fatal if the exposure is significant.

2421

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

FIRE HAZARDS

Lower Flammable Limit: Not combustible
Upper Flammable Limit: Not combustible
Behavior in Fire: Noncombustible substance that is a strong oxidizer and may support and possibly greatly intensify surrounding fires upon release. There is a possibility that some substances that do not normally burn in air will ignite or explode upon contact with the liquid or in a highly oxidizer enriched atmosphere. Containers may rupture violently in a fire, suddenly releasing large quantities of extremely toxic oxidizing gases into the atmosphere.
Hazardous Combustion Products: Product may decompose and evolve oxygen and other gases in a fire, including less complex oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: Not combustible
Upper Explosive Limit: Not combustible
Explosiveness: Containers of nitrogen trioxide do not normally have pressure relief valves or devices. They may rupture violently in a fire or if exposed to excessive heat for sufficient time duration. The substance is a strong oxidizer that may cause a wide variety of materials to ignite or explode upon contact.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with liquid or gaseous nitrogen trioxide and the various oxides of nitrogen it forms in contact with air. This may include rubber boots, gloves, face shields, gas-tight safety goggles, and other impervious and resistant clothing for normal working conditions. Several authorities strongly recommend the use of fully encapsulating suits with self-contained breathing apparatus (SCBA) to prevent contact in the event of a discharge. Materials reported as probably compatible with nitrogen tetroxide and nitrogen dioxide include chlorinated polyethylene, polyethylene, chlorobutyl rubber, and CR 39. Those reported as probably compatible with nitric oxide include butyl rubber, polyvinyl chloride (PVC), and chlorinated polyethylene.
Respiratory Protection: Given the complex mixture of hazardous gases, vapors, and fumes that may be present in air, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent) should be used under all emergency conditions. If a gas mask or chemical cartridge respirator providing protection against the nitrogen oxides of concern is used where contaminant concentrations in air are very low, the devices should not contain oxidizable sorbents such as activated charcoal or carbon and should only be used under the direction of a qualified expert.

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, nose, throat, or skin; other symptoms of exposure to the nitrogen oxides of concern.
First Aid for Inhalation: Anyone exposed even momentarily to excessive concentrations of nitrogen oxides in air should receive immediate attention. Carry victim to fresh air and keep warm and at absolute rest despite lack of any apparent ill effects. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Get medical attention immediately. Qualified personnel should administer oxygen as soon as possible to prevent or minimize the possibility of pulmonary edema. Keep the victim warm, quiet, and under medical observation until the danger of delayed pulmonary edema has passed (at least 72 hours). Physical exertion should be completely discouraged as it may increase the severity of resulting pulmonary edema or chemical pneumonitis. Note that there are specific medical treatment protocols recommended for exposure to these substances. If vomiting occurs naturally, have the victim lean forward with head below hips to reduce the risk of aspiration of fluids into the lungs.
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention immediately. (Note: These recommendations apply to both the liquid contaminant and its gases, vapors, or fumes in air. Be advised that there is some possibility that certain types of clothing may ignite at some point after contamination.) If signs of frostbite are apparent, do not use hot water and do not rub frozen areas.
First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have the victim lean forward with head below hips to reduce the risk of aspiration of fluids into the lungs. If signs of frostbite are apparent, do not use hot water and do not rub frozen areas.

FIRE RESPONSE

Extinguishing Materials: Authorities disagree. The USDOT (1990) recommends that only water spray or fog be used on small fires or where a fire must otherwise be fought. It specifically says not to apply dry chemical, carbon dioxide or Halon, but its rationale for avoiding all alternatives is unclear. Many others recommend use of water, foam, carbon dioxide, or dry chemical on surrounding fires as necessary. It would appear best to follow USDOT recommendations or to use other extinguishing agents with due caution. In particular, note that certain Halons have the potential to react violently with the nitrogen oxides of concern.

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

FIRE RESPONSE (continued)

Extinguishing Techniques: Unusual toxic gas, corrosive fume, and oxidizing agent hazard. Keep combustible and oxidizable materials away from spilled material. Stop leak if you can do it without risk. Stay upwind. Wear breathing apparatus and appropriate protective clothing, including fully-encapsulating vapor-protective suit where contact with material or its vapors or fumes is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may rupture violently and suddenly release its contents when exposed to high heat. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area and out of low areas. Avoid all contact with discharged product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Note that nitrogen trioxide should preferably be withdrawn from cylinders as a liquid when desired or necessary to prevent dissociation of the product to nitric oxide, nitrogen dioxide, and nitrogen tetroxide. Prior to such withdrawals, the cylinder should preferably be cooled (using an ice-water bath, for example). A manufacturer of the product suggests that one way to handle disposal of leaking cylinders is to "Put on . . . breathing equipment. Transfer cylinder to a (lab) hood and cool in ice-water. Attach appropriate needle valve with piece of suitable flexible tubing to the cylinder valve. Run the liquid nitrogen trioxide into excess 10% aqueous sodium hydroxide solution. Transfer to plant disposal unit for neutralization and disposal." Since there may be a possibility that reverse flow into a cylinder may cause rupture use a check valve or other protective device in any line or piping from a cylinder to prevent reverse flow. Take the extremely toxic and reactive nature of the nitrogen oxides of concern into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow airborne contaminants to dissipate. Nitrogen trioxide discharges may expose downwind areas to toxic concentrations of various nitrogen oxides over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE ,

WATER FOG OR SPRAY . . . Water fog or spray applied to the nitrogen oxides of concern in air may absorb or knockdown gases, vapors and fumes and/or accelerate their dispersal in the atmosphere. Apply water at a point downwind and away from any exposed liquid pools of nitrogen trioxide to avoid contact with water and possible acceleration of vapor evolution.

CONSEQUENCE

Water runoff may contain various oxides of nitrogen and corrosive nitric and nitrous acids from contact with airborne gases, vapors and fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff' or rainwater that may add to spill volume and overfill impoundments.

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid nitrogen trioxide or water runoff that is contaminated with oxides of nitrogen and/or nitric and nitrous acids may be contained by building dikes using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained liquids and spread of contamination.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Be alert to conditions such as excessive fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking liquid nitrogen trioxide or contaminated water runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove or neutralize contained liquids as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated pools of liquid nitrogen trioxide or contaminated water may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the accumulated liquids may become damaged or develop leaks. High pressures may develop in equipment if an attempt is made to recover pools of cold liquid nitrogen trioxide and the equipment is warmer than the liquid.

MITIGATION

Use equipment of proper pressure capacity that is compatible with the accumulated liquid and/or any acids that may have formed in contact with moisture or water. Where an attempt is to be made to recover cold liquid nitrogen trioxide, consider using a non-reactive cold gas such as nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates of the product upon its entry into equipment. Ensure that the equipment is completely clean and dry.

TECHNIQUE

ABSORPTION . . . Where deemed necessary, spreading of contaminated water runoff may be controlled by absorption of the liquid with sand, earth, clay, compatible commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the contaminated liquids. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under the guidance of a qualified expert. Note that noncombustible, non-oxidizable sorbents should be used in order to reduce the risk of fire.

TECHNIQUE

NEUTRALIZATION . . . Application of appropriate neutralization agents may modify nitrogen trioxide or contaminated water runoff to less hazardous substances.

CONSEQUENCE

Application and removal of chemical neutralization agents may entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

NITROGEN TRIOXIDE
Division 2.3 (Poison Gas)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and/or liquid residues may be removed by shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Certain oxidizable substances that have been exposed to the nitrogen oxides and acids of concern may possibly be ignited or caused to explode by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with the spilled product and any nitric and nitrous acids which may form in the presence of moisture or water. Store contaminated materials in a safe and secure location. Do not operate motorized equipment where their use may lead to ignition of combustible materials. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . If liquid nitrogen trioxide or significantly contaminated water runoff enters a body of water, notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Although much of any liquid nitrogen trioxide will boil and vaporize as it sinks in water, some portion may dissolve. The water may contain a variable mixture of nitrogen trioxide, nitrogen dioxide, nitrogen tetroxide, nitric acid, and/or nitrous acid as various reactions take place over time. This recommendation and those that follow may not be required in cases simply involving contaminated water runoff if the contaminants will be diluted below harmful levels. Seek guidance from a qualified expert where necessary.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Where necessary, contaminated water may be contained (or diverted to an impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Where necessary, application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1989

NITROUS OXIDE
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Nitrous oxide is a nonflammable compressed or refrigerated liquefied gas with an odor described as ranging from sweet to acrid. Also known as "laughing gas", the product is used as an anesthetic in dentistry and surgery, and also has uses as an aerosol propellant, for making other chemicals, in leak detection, and in rocket fuels. Slightly soluble and heavier than water, it is expected to sink while rapidly boiling and dissolving very slowly. Spills on either land or water may generate relatively large amounts of heavier than air vapors that may accumulate and persist in pits, hollows, and depressions. Containers may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. Discharges under fire conditions may accelerate and intensify the burning of other combustible materials since the product is normally a mild oxidizing agent. Exposure to high temperatures, however, may cause dissociation to elemental nitrogen and oxygen and enhance the oxidizing effect, and this dissociation has been described as being potentially explosive at times. The liquid product weighs approximately 10.2 pounds per gallon near its boiling point and 6.2 pounds per gallon at room temperature.

Nitrous oxide does not react with water, is noncorrosive to common metals, and is stable in normal transportation. As noted above, it is a mild oxidizing agent, and it is also reactive with a variety of other chemicals. Toxicity of the product is low in acute exposures, but it may be present in air in very high concentrations. Contact with the cold liquid or gas may result in frostbite.

Although the inhalation toxicity of nitrous oxide is quite low, downwind evacuation should be considered if the product is leaking until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.1211g/100g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, oils, ether, and concentrated sulfuric acid.

Specific Gravity (Liquid): 1.226 at boiling point; 0.745 at 70°F (21.1°C)

Boiling Point: –127.3°F (– 88.5°C) at 1 atm.

Melting Point: –131.4°F (–90.8°C)

Freezing Point: See melting point

Molecular Weight: 44.0

Heat of Combustion: Not flammable

Vapor Pressure: 51.7 atm (759.7 psia) at 70°F (21.1°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable in normal transportation

Corrosiveness: Noncorrosive; may be used with common structural metals, but may dissolve some plastics containing plasticizers.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Forms flammable mixtures, some of which may ignite spontaneously, with tungsten carbide (when heated), hydrazine, lithium hydride, powdered aluminum, amorphous boron (when heated), and gaseous sodium (when heated). Mixture with phosphine may explode if ignited. Mixture with phenyllithium forms unstable compound. Avoid contact with flammable or combustible materials, especially oil and grease.

IDENTIFICATION

Shipping Names: Nitrous oxide (USDOT and IMO); nitrous oxide, refrigerated liquid (USDOT and IMO); nitrous oxide, compressed (USDOT).

Synonyms and Tradenames: Dinitrogen oxide; dinitrogen monoxide; hyponitrous acid anhydride; factitious air; laughing gas.

Chemical Formula: N_2O

Constituent Components (96 each): 97% or more pure

49 STCC: 49 043 40 (compressed); 49 043 45 (refrigerated)

UN/NA Designation: UN1070 (compressed); UN2201 (refrigerated)

IMO Designation: 2.2, nonflammable gas

Physical State As Shipped: Compressed or refrigerated liquefied gas

Physical State As Released: Gas or boiling liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Sweet to acrid

Common Uses: Anesthetic in dentistry and surgery; aerosol propellant; in leak detection; in rocket fuels; making other chemicals.

NITROUS OXIDE

Division 2.2 (Nonflammable Gas)

See UN/NA Designation for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Extremely volatile liquefied gas that is heavier than air and may persist in pits, hollows, or depressions. Noncombustible but is a mild oxidizer that will accelerate and intensify the burning of combustible material in a fire. Dissociates to elemental nitrogen and oxygen at high temperatures and becomes stronger oxidizing agent. Some nonflammable materials will burn in nitrous oxide. May also decompose explosively at high temperatures, but note that little decomposition occurs below 1200°F (648°C).

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact with very cold liquids, gas, or containers.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the very high gas concentrations that may be present in air in the immediate spill area and some distance downwind. Physical contact may result in frostbite. Note that chronic inhalation of nitrous oxide is suspected but not confirmed to cause increased birth defects, miscarriages, and other problems among dental health professionals in occupational exposures.

Hazards of Skin or Eye Contact: Contact with liquid nitrous oxide or cold gas streams can freeze bodily tissues and result in frostbite type burns.

Hazards of Inhalation: Nitrous oxide gas is a nontoxic and nonirritating asphyxiant that may cause brain damage or death by displacement of oxygen at very high concentrations in air in acute exposures. Somewhat lower concentrations may cause air hunger, headache, dizziness, nausea, vomiting, bewilderment, and loss of consciousness. Inhalation of high concentrations for a few seconds affects the central nervous system and may produce a type of hysteria.

Hazards of Ingestion: Due to its very low boiling point and low solubility in water, ingestion of nitrous oxide is not considered likely.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Not flammable but may accelerate and intensify burning of other materials. Containers may rupture violently in fire due to over-pressurization.

Hazardous Combustion Products: Decomposes to elemental nitrogen and oxygen at high temperatures.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: Not flammable but containers may rupture violently in fire due to overpressurization. Nitrous oxide is said to have the potential to decompose explosively at high temperatures. Contact with other chemicals such as phosphine or phenyllithium may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from contact with liquid nitrous oxide, cold gas streams, or cold equipment to prevent frostbite. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full face-piece (or the equivalent).

1070

NITROUS OXIDE
Division 2.2 (Nonflammable Gas)

FIRST AID

Nonspecific Symptoms: Frostbite from physical contact; headache, dizziness, nausea, or other symptoms of excessive inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: Do not use hot water or rub frozen area. Treat for frostbite if necessary.)

FIRE RESPONSE

Extinguishing Materials: Nitrous oxide is not flammable. Use water spray or fog, dry chemical, carbon dioxide, or foam as necessary on surrounding fire.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to pools of liquid nitrous oxide may increase gas evolution.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the highly volatile and heavier than air nature of nitrous oxide into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . .Although the inhalation toxicity of the spilled product is relatively low, it may be prudent to consider downwind evacuation when exposed populations may be subjected to prolonged high concentrations in air. Otherwise, monitor the situation and restrict access to the immediate spill area and areas immediately downwind by unprotected personnel.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to nitrous oxide vapors or fumes may accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not permit it to contact pools of liquid nitrous oxide as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of nitrous oxide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

NITROUS OXIDE
Division 2.2 (Nonflammable Gas)

TECHNIQUE

FOAM . . .There is a possibility that application of an appropriate firefighting foam applied to the surface of quiescent liquid pools may slow the release of nitrous oxide vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid nitrous oxide may be contained by building dikes or barriers using soil, sand or other materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines. (Note: Most if not all residue will rapidly evaporate.)

CONSEQUENCE

Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Very little of the spilled product will dissolve as it sinks and boils in water. Water spill responses may only be required in special cases. Consult qualified experts for advice.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

NITROUS OXIDE
Division 2.2 (Nonflammable Gas)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

OCTANOL
Combustible Liquid

GENERAL INFORMATION

Octanol, also known as octyl alcohol (normal isomer), is a colorless relatively nonvolatile liquid with a sweet, penetrating, and aromatic odor. It is used to make perfumes and other chemicals, to mask industrial odors, and for formulating wetting and foam control agents. It is slightly soluble in water and lighter, so may be expected to form a floating surface slick that dissolves at a slow rate. Its flash point of 178°F indicates that the product must be heated before it can be easily ignited. There is some very limited potential that containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.9 pounds per gallon.

Octanol does not react with water or many other common materials and is stable in normal transportation. It is reactive with strong oxidizing agents, and such agents may cause its ignition. Toxicity of the product is considered low to moderate by the various routes of exposure. Products of combustion are considered acrid and may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.6 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in chloroform, ethyl alcohol, and diethyl ether.
Specific Gravity (Liquid): 0.829 at 68°F (20°C)
Boiling Point: 381-383°F (194 –195°C) at 1 atm.
Melting Point: 1.9 to 5°F (– 16.7 to – 15°C)
Freezing Point: 1.9 to 5°F (– 16.7 to – 15°C)
Molecular Weight: 130.23
Heat of Combustion: – 8963 cal/g
Vapor Pressure: 0.2 mm Hg (0.004 psia) at 68°F (20°C)
Flash Point: 178°F (81.1°C), closed cup.
Autoignition Temperature: Unavailable
Burning Rate: 3.7 mm/minute (approx.)
Stability: Stable
Corrosiveness: Noncorrosive
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizing agents.

IDENTIFICATION

Shipping Names: Alcohol, N.O.S. (USDOT)
Synonyms and Tradenames: Octyl alcohol; n-octanol; 1-octanol; n- or 1-octyl alcohol; n-octan-1-ol; alcohol C-8; capryl alcohol; caprylic alcohol; Dytol M-83; heptyl carbinol; Lorol 20; octilin; Sipol L8; 2-ethyl-hexyl alcohol; 2-ethyl hexanol; WLNL Q8.
Chemical Formula: $CH_3(CH_2)_6CH_2OH$
Constituent Components(% each): Varies up to 100% pure.
UN/NA Designation: UN1987
IMO Designation: Not regulated
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, penetrating, aromatic
Common Uses: Mfg. perfumes and esters; masking of industrial odors; wetting agents; foam control agent.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

OCTANOL

Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 2 ppb - 0.53 ppm; reported values vary.

Unusual Hazards: None

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Hazards are relatively limited.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid octanol may cause some degree of drying, cracking, and inflammation of the skin due to the defatting action of the product. Some amounts may be absorbed through the skin. Contact with the eyes may result in irritation and temporary corneal injury.

Hazards of Inhalation: The low vapor pressure of octanol suggests limited potential for high vapor concentrations in air. Exposures to prolonged high concentrations may be expected to cause temporary disorders of the central nervous system with symptoms including headache, dizziness, and nausea.

Hazards of Ingestion: Octanol is of relatively low oral toxicity in single doses based upon animal experiments.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite. There is some remote chance that containers may rupture violently in fire.

Hazardous Combustion Products: Considered acrid, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of heated liquid are ignited in a confined area. There is some remote chance that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include natural rubber, neoprene, nitrile rubber, polyvinyl alcohol, and polyvinyl chloride.

Respiratory Protection: For fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the skin or eyes; central nervous system disorders.

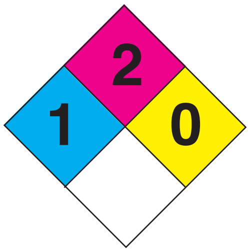
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim’s lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

1987

OCTANOL
Combustible Liquid



FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of octanol may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that octanol is a combustible liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Octanol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of octanol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to octanol vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of octanol from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of octanol vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

OCTANOL
Combustible Liquid

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Octanol may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained octanol may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

OCTANOL
Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating octanol.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

OCTANOL
Combustible Liquid

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with octanol may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified

September 2003

1-OCTENE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

1-Octene is a clear, flammable liquid with a hydrocarbon like odor. It is employed in the production of surfactants and used as an additive to many polymeric formulations. It is very flammable, having a low flash point of 70°F (open cup), and is reactive with strong acids and oxidizing agents. While being soluble in a variety of hydrocarbon solvents, its solubility in water is negligible. It is expected to float on water (as it is lighter than water and only negligibly soluble). The product weighs approximately 6 pounds per gallon.

1-Octene is stable and will not polymerize. Symptoms of exposure may include skin defatting and central nervous system effects, such as headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death. 1-Octene has an evaporation rate of 1.3 and is therefore considered a relatively fast evaporator, thereby increasing health and fire hazards. Fumes and vapors are heavier than air, may form explosive mixtures with air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of 1-octene is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible
Solubility in Other Chemicals: Soluble in hydrocarbon solvents, alcohol, acetone, ether, petroleum, benzene, chloroform and coal tar solvents.
Specific Gravity (Liquid): 0.72
Vapor Density: 3.9
Boiling Point: 250-253°F (121-123°C)
Melting Point: -151.0°F (-101.7°C)
Freezing Point: See melting point
Molecular Weight: 112.2
Heat of Combustion: 1269.3 kcal/mole
Evaporation Rate (butyl acetate=1): 1.3
Vapor Pressure: 15 - 36 mm Hg at 68°F (20°C)
Flash Point: 50°F (10°C) closed cup; 70°F (21°C) open cup
Autoignition Temperature: 430°F (221°C)
Burning Rate: 6.5 mm/min
Flammable Limits: 0.8% (LFL) - 6.7% (UFL)
Stability: Stable
Polymerization Potential: Will not occur
pH: Unavailable
Reactivity with Water: None
Reactivity and Incompatibility: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates and peroxides.

IDENTIFICATION

Shipping Name(s): Flammable liquid, n.o.s. (1-Octene) or Hydrocarbons, liquid, n.o.s. (1-Octene) (USDOT & IMO)
Synonyms and Tradenames: Oct-1-ene; Caprylene; Octene-1; 1-Octylene; alpha-Octylene
CAS Registry No.: 111-66-0
Chemical Formula: $CH_3(CH_2)_5CHCH_2$
Constituent Components (% each): 97% to 100% pure
UN/NA Designation: UN1993, UN3295
IMO Designation: 3, Flammable liquids
RTECS Number: Unavailable
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless liquid
Odor Characteristics: Hydrocarbon odor
Common Uses: Used as an additive to many polymeric formulations. A co-monomer for linear low density polyethylene. Employed in the production of surfactants (detergent alcohols and alkyl aromatics).

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

*

*Also 3295

1-OCTENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 2 ppm

Unusual Hazards: Fumes and vapors are heavier than air. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers. Avoid inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Skin defatting: may include drying and reddening of the skin. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death.

Hazards of Skin or Eye Contact: Causes skin and eye irritation. Contact with the skin is not expected to cause prolonged or significant irritation. Skin contact may cause drying or defatting of the skin. Not expected to be harmful to internal organs if absorbed through the skin.

Hazards of Inhalation: Expected to be irritating to respiratory tract. Symptoms of overexposure to vapors may include drowsiness, weakness, headache, dizziness and nausea.

Hazards of Ingestion: Causes gastrointestinal irritation with nausea, vomiting and diarrhea. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.

FIRE HAZARDS

Lower Flammable Limit: 0.8%

Upper Flammable Limit: 6.7%

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas, and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable and toxic vapors upon release.

Hazardous Combustion Products: Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with flash protection and SCBA may be required.

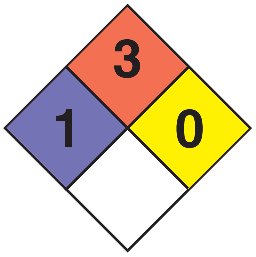
Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1993*

*Also 3295

1-OCTENE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of any bodily tissues or central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility if irritation develops or persists. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, regular foam, water spray or carbon dioxide.

Extinguishing Techniques: Toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Do not use a solid stream of water, since the stream may scatter and spread the fire. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: 1-Octene is a highly flammable liquid that may cause environmental contamination. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited to spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

1-OCTENE

Class 3 (Flammable Liquid)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . 1-Octene may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

1-OCTENE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

1-OCTENE

Class 3 (Flammable Liquid)

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Sorbent pads or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating product.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Sorbent pads, peat or commercial sorbent materials compatible with product may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

September 2003

OCTYL ALDEHYDES

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Octyl aldehyde is a clear, flammable liquid with a strong citrus-like odor. It is commonly called octanal or caprylaldehyde and is used as a fragrance, an additive to food or liquor or as a chemical intermediate in the production of linear alcohols. It has a flash point of 124°F and therefore flammable, but it can be identified as a flammable or combustible liquid when in transportation. It is reactive with strong oxidizing agents, strong bases and strong reducing agents. The product weighs approximately 6.8 pounds per gallon.

Octyl aldehyde is stable and will not polymerize. Having a specific gravity of 0.821 and being only slightly solubility in water, much of the product is expected to form a floating layer on water. For this reason, if product is on fire, a straight stream of water should not be used as it may possibly spread the fire. It has a low vapor pressure of 0.85 mm Hg at 77°F and is therefore not likely to have high quantities of the material in a vapor state. However, fumes and vapors are heavier than air, may form explosive mixtures with air and may travel to a distant source of ignition and flash back. Excessive heat may cause rupture of containers.

Symptoms of exposure may include irritation of all bodily tissue and central nervous system effects, such as headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion or disorientation. Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if product is leaking but not on fire. If container of octyl aldehyde is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): 0.821
Vapor Density: 4.42
Boiling Point: 340°F (171°C)
Melting Point: 54 - 59°F (12 - 15°C)
Freezing Point: See melting point
Molecular Weight: 128.2
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): Unavailable
Vapor Pressure: 0.85 mm Hg at 77°F (25°C)
Flash Point: 124°F (51°C)
Autoignition Temperature: 410°F (210°C)
Burning Rate: Unavailable
Flammable Limits: Unavailable
Stability: Stable under normal conditions
Polymerization Potential: Has not been reported
Reactivity and Incompatibility: May react with strong oxidizing agents, strong bases and strong reducing agents.

IDENTIFICATION

Shipping Name(s): Octyl Aldehydes (USDOT & IMO)
Synonyms and Tradenames: 1-Octaldehyde; 1-Octanal; 1-Caprylaldehyde; 1-Octylaldehyde; ALDEHIDO C-8; Aldehyde C8; C8 aldehyde; n-Octaldehyde; n-octanal; n-Octyl Aldehyde; octanal; Caprylaldehyde; Caprylic aldehyde; normal-Octaldehyde
CAS Registry No.: 124-13-0
Chemical Formula: $C_8H_{16}O$
Constituent Components (% each): 92% to 100% pure
UN/NA Designation: UN1191
IMO Designation: 3, Flammable liquids
RTECS Number: RG7780000
NFPA 704 Hazard Rating: 2 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless liquid
Odor Characteristics: Lemon-lime, citrus
Common Uses: Used as a fragrance agent, i.e., for soaps, detergents, perfumes and creams; flavoring agent, i.e., for baked goods, candy and gelatins; chemical intermediate in production of linear alcohols from olefins.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

OCTYL ALDEHYDES

Class 3 (Flammable Liquid) or Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Fumes and vapors are heavier than air. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers. Avoid inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Causes irritation to all bodily tissues and possibly central nervous system depression. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion or disorientation.

Hazards of Skin or Eye Contact: Causes skin and eye irritation. May cause chemical conjunctivitis and corneal damage. May cause dermatitis or cyanosis of the extremities.

Hazards of Inhalation: Causes respiratory tract irritation. Vapors may cause dizziness, burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting and possibly suffocation. Can produce delayed pulmonary edema.

Hazards of Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. Ingestion of large amounts may cause central nervous system depression.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquid. Vapors are heavier than air, may collect in low areas, and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable and/or toxic vapors upon release.

Hazardous Combustion Products: Products of combustion may include carbon dioxide, carbon monoxide and irritating and toxic fumes and vapors.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

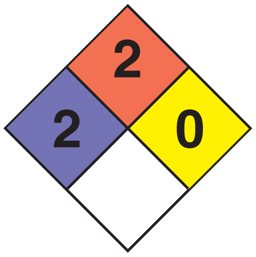
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1191

OCTYL ALDEHYDES

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of any bodily tissues or central nervous system depression.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, alcohol-resistant foam, water spray or carbon dioxide.

Extinguishing Techniques: Toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire-exposed containers cool. Do not use a solid stream of water, since the stream may scatter and spread the fire. Water spray may be used to dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

SPILL RESPONSES

General Information: Octyl aldehyde is a flammable liquid. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited to spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

OCTYL ALDEHYDES
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The use of water in flooding quantities may reduce the generation of vapors. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Octyl aldehyde may be contained by building dikes or barriers using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained product may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible, impervious material.

OCTYL ALDEHYDES

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

NOTE: The techniques described below are for floating, undissolved liquids. Due to the fact that some amount of the chemical is expected to dissolve, other techniques should be considered, such as aeration and adsorption.

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

OCTYL ALDEHYDES

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Sorbent pads or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating product.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Sorbent pads, peat or commercial sorbent materials compatible with product may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

March 1995

OLEUM

Class 8 (Corrosive Material)

GENERAL INFORMATION

Oleum, also known as fuming sulfuric acid, consists of sulfuric acid with various amounts of dissolved sulfur trioxide that may combine with water in the air or in solution to produce additional sulfuric acid. It is a colorless to cloudy or even black fuming liquid that has a sharp, penetrating and choking odor, and is used in petroleum refining and the making of various chemicals, dyes, and explosives. It is not flammable but is a strong oxidizer and highly reactive substance that will char wood upon contact and may ignite various combustible materials, particularly if they are finely divided. Contact with most metals generates flammable and potentially explosive hydrogen gas. There is some limited potential that containers may rupture due to overpressure if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 16-16.6 pounds per gallon depending on the amount of sulfur trioxide present.

Oleum reacts vigorously or violently with water with the generation of much heat and spattering. The product is highly corrosive to most metals and may react with explosive violence in contact with cast iron. It is also highly corrosive to bodily tissues, and is reactive with a wide variety of chemicals and substances, possibly causing fires and explosions. Toxic and irritating vapors are generated upon heating and in fires.

If oleum is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. These fumes and vapors may be heavier than air. (Note: Oleum is available in various grades containing from 20-65% free sulfur trioxide. These are equivalent to grades with 104.5-114.63% sulfuric acid. The 65% grade of oleum has the lower boiling point and the higher vapor pressure. Cretain grades between 20 and 65% oleum may solidify at room temperatures.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions but reacts (see below).

Solubility in Other Chemicals: Decomposes in alcohol

Specific Gravity (Liquid): 1.915-1.992 at 60°F (15.6°C)

Boiling Point: 136.4-287.6°F (58-142°C) at 1 atm; may decompose

Melting Point: 23°F (– 5°C) for 20%; 35.6°F (2°C) for 65%

Freezing Point: over 90°F (32°C) for 45%

Molecular Weight: 98.08 for H_2S0_4; 80.06 for S03

Heat of Combustion: Not flammable

Vapor Pressure: 1-145 mm Hg (0.019-2.80 psia) at 77°F (25°C); varies with grade.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Normally stable

Corrosiveness: Highly corrosive to many metals, plastics, and rubbers, particularly in the presence of water. Compatible with glass and teflon.

Reactivity with Water: Reacts vigorously or violently producing much heat and spattering.

Reactivity with Other Chemicals: Reacts with organic compounds, combustible materials, carbides, chlorates, sulfides, fulminates, nitrates, picrates, metals, cyanides, sodium, sodium carbonate, bases, potassium permanganate, phosphorus, saltpeter, lithium silicide, mercuric nitride, nitrotoluene, acetone cyanohydrin, acetone and nitric acid, and numerous other chemicals and materials. Many reactions are extremely hazardous.

IDENTIFICATION

Shipping Names: Sulphuric acid, fuming (USDOT and IMO).

Synonyms and Tradenames: Fuming sulfuric acid; fuming sulphuric acid.

Chemical Formula: H_2S0_4 (sulfuric acid); $S0_3$ (sulfur trioxide).

Constituent Components(% each): Various grades with 20-65% free $S0_3$ (104.5-114 63% H_2SO_4).

UN/NA Designation: UN1831

IMO Designation: 8, corrosive

Physical State as Shipped: Liquid

Physical Shte as Released: Liquid

Color of the Shipped Material: Colorless to cloudy and even black

Odor Characteristics: Sharp, penetrating, choking

Common Uses: Petroleum refining; mfg. various chemicals, dyes, and explosives.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

OLEUM
Class 8 (Corrosive Material)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 1 mg/m^3

Unusual Hazards: Highly corrosive acid and oxidizer. May char or ignite combustible materials. Reacts violently or vigorously with water and many other substances. Contact with metals may generate flammable hydrogen gas. May react explosively with cast iron.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): 1 mg/m^3 H_2S0_4 over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat or fire; sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with oleum or its concentrated fumes or vapors in air may result in severe, deep, and painful burns. Extensive burns may cause shock and collapse.

Hazards of Inhalation: Fumes and vapors of oleum may cause irritation of the eyes, nose, throat and upper respiratory tract as well as erosion of the teeth and soreness of the mouth. High concentrations in air may cause sneezing, coughing, difficult breathing, and laryngeal, tracheobronchial and pulmonary edema with possibly severe consequences.

Hazards of Ingestion: Ingestion of oleum may result in severe burns of the mouth and throat, perforation of the esophagus or stomach, staining and erosion of teeth, nausea and vomiting of blood and eroded tissue, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: There is some limited potential that containers may rupture violently in fire due to overpressurization. May generate large quantities of corrosive vapors and fumes upon release.

Hazardous Combustion Products: Toxic and irritating gases may evolve in fires.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: There is some limited potential that containers may rupture violently in fire due to overpressurization. Contact with various other chemicals and substances may result in violent or explosive reactions (see General Information section). Contact with many metals produces hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, neoprene, nitrile rubber, chlorinated polyethylene, polyvinyl chloride, styrene-butadiene rubber, Viton, and nitrile-butadiene rubber for concentrated (more than 70%) sulfuric acid.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 50 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask

1831

OLEUM
Class 8 (Corrosive Material)

FIRST AID

Nonspecifc Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but note that oleum may react violently with water. Water (if used) should be applied in flooding quantities as fog or spray.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may be dangerous. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that oleum is highly corrosive and reactive. Contact with metals may produce flammable and potentially explosive hydrogen gas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Oleum spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts of fumes and vapors are evolved.

CONSEQUENCE

Need to notify, organize, transport, and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Oleum may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if only small amounts have spilled.

CONSEQUENCE

Hazardous levels of oleum may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

OLEUM

Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to oleum vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of oleum as this may cause a violent reaction.

CONSEQUENCE

Water runoff may contain sulfuric acid from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid oleum may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid oleum may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Oleum may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained oleum may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

These may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

OLEUM
Class 8 (Corrosive Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

OLEUM
Class 8 (Corrosive Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Hydroxide based anion exchangers may also be effective.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

October 1991

OXYGEN
Division 2.2 (Nonflammable Gas)

GENERAL INFORMATION

Oxygen is a colorless, odorless, nonflammable and practically nontoxic element of nature that makes up about 21% of the atmosphere by volume. It is handled in commerce as a compressed gas under high pressure or as a refrigerated cryogenic liquid at extremely low temperatures. It is has a wide variety of uses in making various chemicals, to enhance combustion processes, as an inhalant in medicine and in high altitude and deep sea operations and for oxidizing organic substances. Due to its slight solubility in water and a boiling point of approximately –287.4 F spills of liquid oxygen on land or water or ruptures of compressed gas containers may generate large amounts of gas that may appear white at first due to condensation of water vapor in the air. Any gas that is very cold may be heavier than air and may persist in pits, hollows and depressions, but will approach the density of air as it warms. Containers of compressed or liquid oxygen may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The refrigerated liquid weighs about 9.52 pounds per gallon at its boiling point temperature.

Since compressed oxygen gas is shipped at temp eratures far in excess of its critical temperature of –181.4°F –118.6°C), this being the temperature above which it cannot be liquefied regardless of the pressure applied, the weight of gas within a container is a function of the volume of the container, the temperature of the gas, and the degree to which it is pressurized. These pressures can vary, but usually approximate or exceed 137 atmospheres (2000 psig) at room temperature within gas cylinders. Gaseous oxygen may also be shipped in bulk in tube trailers at pressures up to 181 atmospheres (2640 psig). Conversely, most liquid oxygen is shipped in bulk at very cold temperatures and at pressures below 2.66 atmospheres (25 psig) in specially insulated cargo tanks on trucks and truck trailers or in specially insulated tank cars. Be advised, however, that some insulated tank cars transporting liquid oxygen may have internal pressures as high as 14.6 atmospheres (200 psig) with temperatures on the order of –232°F (–146.5°C).

Oxygen is fully stable in transportation and noncombustible. It is a strong oxidizer, however, that will actively support the burning of combustible materials. Some materials that will not burn in air will burn in an oxygen-enriched atmosphere and materials that burn in air will burn more vigorously. A wide variety of combustible materials may ignite and/or explode if exposed to high levels of oxygen. Liquid oxygen presents a high risk of explosion in contact with combustible or oxidizable materials. Of special interest is that a violent re action and possibly an explosion may occur if liquid oxygen is spilled on asphalt or spilled on another surface contaminated with combustibles (such as oil-soaked concrete or gravel), and if the surface is then subjected to shock or impact. Do not walk on or roll equipment over a surface thus contaminated for at least one-half hour after all visible signs of frost have disappeared.

Although oxygen is essentially nontoxic it may cause tissue damage and burns due to frostbite.

If a bulk container of oxygen is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently. If a compressed gas cylinder is so threatened, evacuate for a radius of one-third (1/3) mile.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; one volume of gas dissolves in 32 volumes of liquid water at 68°F (20°C)

Solubility in Other Chemicals: Very slightly soluble in alcohol and other organic liquids

Speciric Gravity (Liquid): 1.14 at –297.4°F (–183°C)

Boiling Point: –297.4 to –297.3°F (–183 to –182.9°C) at 1 atm.

Melting Point: –361.8 to –360.4°F (–218.8 to –218°C)

Freezing Point: See melting point

Molecular Weight: 32.0 as O_2; (the form found naturally in nature)

Heat of Combustion: Not flammable

Vapor Pressure: Approx 49.77 atm (731.1 psia) at –181.4°F (–118.6°C). This is the critical pressure and related critical temperature of oxygen. See the General Information section above for further details.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Not corrosive to common metals but systems containing oxygen must be constructed to withstand the high pressures and/or low temperatures that may be present.

Reactivity with Water: *No* reaction, but contact of very cold liquid oxygen with water may result in vigorous or violent boiling and extremely rapid vaporization of the oxygen due to the large temperature differences involved. Pressures may build to dangerous levels if this occurs in a closed container.

Reactivity with Other Chemicals: Oxygen is a very strong oxidizing agent that may at the very least react violently with or cause the ignition of combustible materials. Mixt ures with combustible organic materials such as oil, grease, coal dust, and many other substances may explode or burn with nearly explosive violence in oxygen if ignited.

IDENTIFICATION

Shipping Names: Oxygen (USDOT and IMO); oxygen, compressed (USDOT and IMO); oxygen, refrigerated liquid (USDOT and IMO)

Synonyms and Tradenames: Liquid oxygen may be referred to as LOX

Chemical Formula: O_2 (the form found naturally in nature)

Constituent Components (% each): Typically 9910 or more pure by volume; remain der may include traces of a wide variety of other gases.

49 STCC: 49 043 50 (oxygen); 49 043 50 (oxygen, compressed); 49 043 60 oxygen, refrigerated liquid, (cryogenic liquid).

UN/NA Designation: UN1072 (USDOT and IMO for oxygen or oxygen, compressed); UN1073 (USDOT and IMO for refrigerated liquid)

IMO Designation: 2.2, nonflammable gas

Physical State As Shipped: Compressed gas or refrigerated cryogenic liquid

Physical State As Released: Boiling liquid, gas, or mixture of gas and aerosols (small liquid droplets) depending upon release conditions and physical state of cargo.

Color of the Shipped Material: Pale blue liquid; a normally colorless gas that may appear white upon release due to condensation of water vapor and possibly other gases from the atmosphere if the oxygen is discharged at a low temperature.

Odor Characteristics: Odorless

Common Uses: Making various chemicals; oxidizer for rocket propellants; inhalant in medicine and in oxygen deficient atmospheres.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

The oxygen placard may
be used instead

OXYGEN
Division 2.2 (Nonflammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Oxygen is odorless

Unusual Hazards: Oxygen is a strong oxidizer that is highly reactive with a wide variety of substances when concentrated or when in liquid form. It is not itself combustible but will support and accelerate the burning of combustible materials. Some substances that do not burn in air may burn in oxygen. A violent reaction and possible explosion may occur if liquid oxygen is spilled on asphalt or other surfaces contaminated with combustibles (such as oil-soaked concrete or gravel) and the surface is then subjected to impact or shock. Many common clothing materials exposed to oxygen-enriched atmospheres or liquid oxygen may be ignited or caused to explode.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Conditions to Avoid: Heat or fire; contact with combustible, oxidizable, reactive or otherwise incompatible materials; ingestion or direct physical contact; excessively prolonged inhalation of highly enriched oxygen atmospheres.

HEALTH HAZARDS

Public Health Hazards: The major hazard appears to be from direct contact with liquid oxygen, very cold oxygen gas, or very cold equipment surfaces that may cause frostbite and other types of burns. It also appears that inhalation of very cold gas for even brief periods may be hazardous. With respect to oxygen gas at normal pressure and temperatures, it appears that inhalation of even pure oxygen for a few hours (at the very least) is unlikely to cause harm, except possibly to premature infants and people with chronic obstructive pulmonary disease.

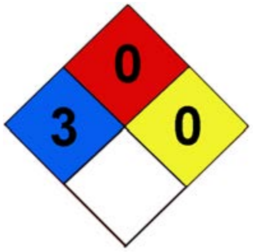
Hazards of Skin or Eye Contact: Contact with liquid oxygen or very cold gas may cause frostbite, freeze burns, and possibly other burn-like injuries of the skin or eyes due to the cold temperatures involved as well as the strong oxidizing properties of the substance. There is some potential for permanent eye injury. Frostbite may also occur from contact with the surface of a very cold container of the product. Be advised and take heed that many types of common clothing materials exposed to an oxygen-rich atmosphere or contaminated with liquid oxygen may be subject to reaction with the oxygen and possible ignition and accelerated burning or explosion, thus potentially causing serious injury to the wearer of the clothing. Exposed clothing should be removed immediately and not used until it has been sufficiently aired out.

Hazards of Inhalation: Most authorities agree that the majority of adult humans can inhale very high concentrations of oxygen at normal atmospheric pressure and temperatures for at least several hours (some claim much longer), either without toxic effect or simply with irritation of mucous membranes due to dryness. After a few hours, and possibly only after 5 to 6 hours, early significant symptoms and signs of exposure are reported to include nasal stuffiness, nausea, coughing, sore throat, chest pain, dizziness, and cramps. As exposures are prolonged and approach 24 hours, more serious effects such as breathing difficulties, bronchial irritation, hypothermia, slowed heart rate, increased depth of respiration, dimness or loss of vision, epileptic seizures, pulmonary edema, pneumonia, collapse, and death may variously be expected. Note, however, that there are indications in the literature that only "brief" exposures to cold oxygen gas are required to potentially produce breathing difficulties and that prolonged inhalation of cold gas may injure the lungs and lead to serious illness. Note also that certain groups of people may be at greater risk than normal. For example, premature infants may suffer permanent visual impairment or blindness from inhalation of oxygen at high concentrations after some unspecified period of time. People with chronic obstructive pulmonary disease retain carbon dioxide abnormally. If exposed to high levels of oxygen, increases in their blood oxygen levels may depress their breathing and possibly result in dangerous levels of retained carbon dioxide, again after an unspecified period of time.

Hazards of Ingestion: Due to its low boiling point temperature, ingestion of liquid oxygen is considered highly unlikely. If it should occur, severe frostbite and possibly burns of the lips, mouth, and other contacted tissues may be expected.

1072

OXYGEN
Division 2.2 (Nonflammable Gas)



FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Nonflammable gas that is a strong oxidizer. Will support and greatly intensify the fire. Containers may rupture violently in a fire due to overpressurization. A massive release of oxygen may catastrophically magnify the fire. Some substances that do not burn in air may burn in an oxygen enriched atmosphere. Contact of liquid oxygen with various fuels and combustible materials may result in an explosion. Ignition of various substances in an oxygen enriched atmosphere may result in an explosion.

Hazardous Combustion Products: Not pertinent

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Mixtures of liquid oxygen or concentrated oxygen gas with a wide variety of materials are subject to explosion under appropriate conditions. Containers may rupture violently in a fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of eye contact with liquid oxygen or very cold gas and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, tight-fitting safety goggles, and other impervious and resistant clothing. Clothing and equipment should be of a type that not will freeze to skin and will not ignite on contact with liquid oxygen or be subject to ignition and burning in an oxygen enriched atmosphere. Preferred materials are those with smooth surfaces which prevent the accumulation of oxygen; they should be clean, oil free, and insulated to the necessary degree. Be advised and take heed that all exposed clothing should be ventilated thoroughly after exposures to eliminate any excess oxygen that may be present. At least one authority suggests that protective clothing should provide total coverage of normal clothing. (Note: Protection from high concentrations of oxygen gas at close to normal temperatures does not necessitate equipment designed for exposure to extremely cold temperatures.)

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent) may be prudent for use where personnel may need to function in a highly enriched oxygen atmosphere for prolonged periods of time or where concentrations of very cold gas may be encountered. Some judgment must be applied for proper selection of protective clothing and equipment to suit the various circumstances under which liquid or compressed oxygen may be released. Where both excess oxygen and a toxic gas are present in air, it may be prudent not to use gas masks or other respiratory protective devices with canisters or cartridges containing oxidizable materials such as activated charcoal or carbon.

FIRST AID

Nonspecific Symptoms: Frostbite or burns of the skin, eyes, or other bodily tissues; effects of excessive and prolonged inhalation of highly oxygen enriched atmospheres or very cold gas.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration and get medical attention immediately.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of warm water. Get medical attention immediately. Do not use hot water or rub frozen areas. Handle potentially contaminated and potentially combustible clothing with appropriate caution due to the possibility of fire or explosion.

First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately. Do not use hot water or rub frozen areas.

OXYGEN
Division 2.2 (Nonflammable Gas)

FIRE RESPONSE

Extinguishing Materials: Water spray, foam, carbon dioxide or dry chemical, as appropriate for surrounding fire. Avoid using Halons; several halogenated compounds are known to react explosively when in contact with liquid oxygen and in the presence of a high energy source of ignition.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing as needed. Move container from fire area if no risk. Stop flow of liquid oxygen or compressed gas if safe to do so and then extinguish fire, unless appropriate extinguishing technique for burning material(s) indicates the fire should not be extinguished until other flows of fuels are stopped. Be alert to the possibility that the container may rupture violently and suddenly release massive amounts of product (which could disastrously magnify the fire) when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or and discoloration of tank due to fire. Avoid direct application of water on safety relief devices, particularly those fitted to liquid oxygen containers, since resultant cold exposure may cause ice to form, thus preventing proper functioning of the devices. When large pools of water-soluble fuels are present, consider using water if safe to do so to dilute the fuel and to reduce the intensity of the fire. When a non-water soluble fuel and liquid oxygen are mixed or mixing but are not yet burning, isolate the area from sources of ignition and get out quickly, allowing the oxygen to evaporate. Note that contact with water may increase vapor evolution from any pools of liquid oxygen that may form on the ground.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Choose equipment that is not damaged by the spilled product and that is suitable for oxygen service. Where necessary, use spark-proof and explosion-proof tools and equipment, eliminate ignition sources, and/or ground all equipment and transfer lines prior to use. Seek expert advice before transferring oxygen from its container to a second container. Ensure that the receiving container has been specially designed and cleaned to receive the product. Never transfer liquid oxygen where it may spill onto gravel or another porous material that may contain oil drippings. Areas where liquid oxygen may be spilled during transfer operations must be free of hydrocarbons (including asphalt) or other combustible materials. In the event liquid oxygen is spilled on asphalt or other surfaces contaminated with combustibles (such as oil-soaked concrete or gravel), do not walk on or roll equipment over the area for at least one-half hour after the frost has disappeared, since a violent reaction or explosion may occur simply by impact or shock. Open any valves on oxygen equipment slowly to avoid possible ignition of particles carried by oxygen flowing at high velocity. Avoid contact of moisture with storage containers to prevent ice from plugging pressure relief devices. Take the many unusual properties and hazards of oxygen into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Oxygen venting from gas cylinders or from relatively small holes in bulk containers may not evolve large amounts of gas in some spill situations or the gas may be released in an area in which it poses no unusual hazards. It may be advisable in such cases to simply monitor the situation until the leak is stopped or flow ceases.

CONSEQUENCE

Potentially dangerous concentrations of oxygen in air may be found in the local spill area and immediately downwind while the container is leaking. Special fire or explosion hazards may exist if the oxygen is leaking within a confined area such as a building.

MITIGATION

Remove people at risk from the various hazards posed by oxygen from the local spill area and areas immediately downwind. Eliminate ignition sources and open flames. Move leaking cylinders outdoors and ventilate confined spaces containing high concentrations of oxygen if safe to do so.

OXYGEN
Division 2.2 (Nonflammable Gas)

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow excessive gas levels to dissipate. Oxygen discharges, particularly from bulk containers or from large containers of liquid oxygen, may expose downwind areas to highly oxygen-enriched atmospheres over considerable distances in some cases. High concentrations may pose fire and explosion threats to nearby populated areas. Prolonged exposure to high concentrations of oxygen in air may be harmful to the health of certain individuals.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. Consider issuing instructions that all open flames be extinguished where practical. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Where deemed necessary to reduce various threats, water fog or spray applied to excess oxygen gas in air may accelerate its dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid oxygen pools with water spray or fog may increase gas evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid oxygen.

TECHNIQUE

FOAM . . . Where deemed necessary to control the rate of gas evolution to reduce various threats, there is a possibility that application of an appropriate firefighting foam to the surface of contained liquid oxygen pools may slow the rate of gas evolution into the atmosphere after an initial increase. (Note: High expansion foams should be considered if available.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, evolution of gas will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed or vaporized. Contain increased volume if necessary. Proceed with caution if the initial increase in gas evolution may adversely affect downwind populations or operational safety. Implement this technique with great caution. Consult qualified experts for assistance.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid oxygen may be contained by building dikes or barriers using dry sand or other compatible materials where conditions permit this action to be safely undertaken. Similarly, storm drains and sewer openings may be sealed using compatible materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product where conditions permit this action to be safely undertaken.

OXYGEN
Division 2.2 (Nonflammable Gas)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may possibly be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product and/or not suitable for liquid oxygen service may become damaged or develop leaks. Very high pressures may develop in equipment.

MITIGATION

Use compatible and appropriate equipment of proper pressure capacity. Consider precooling the equipment with nitrogen or controlled entry of liquid oxygen before initiation of full scale recovery of the liquid to avoid high initial vaporization rates upon entry of the product into the equipment. Ensure that the equipment is sufficiently clean for use with oxygen. Consult qualified experts for guidance.

WATER SPILL

Liquid oxygen will boil or rapidly vaporize from a water body with negligible dissolution. In any event, dissolved oxygen is not harmful to aquatic life.

September 2006

PENTANE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Pentane is a clear colorless liquid hydrocarbon with an odor comparable to gasoline. It is used as a fuel, as a component of aerosol propellants, in solvent extraction processes, for making other chemicals, and as a blowing agent in plastics. Only slightly soluble in water, pentane will float to form a surface slick. Its flash point of about –57°F indicates that it can easily be ignited under all ambient temperature conditions. Its normal boiling point of 97°F indicates that it will boil at high ambient temperatures and will otherwise evaporate rapidly. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapors in confined spaces such as buildings or sewers may result in explosions if ignited, and there is also some known potential for explosions involving unconfined vapor clouds of pentanes. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.2 pounds per gallon.

Pentane does not react with water or other common materials and is stable in normal transportation. It is compatible with most metals but may degrade certain rubbers and plastics. Although toxicity by all routes is generally considered low to moderate, the high volatility of pentane indicates that high vapor concentrations may be present in air. Products of combustion may include toxic constituents.

If pentane is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.04 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, ether, diethyl ether, ethanol, acetone, benzene, chloroform and most organic solvents.

Specific Gravity (Liquid): 0.626 at 68°F (20°C)

Vapor Density: 2.5

Boiling Point: 95.0 – 97.3°F (35.0 – 36.3°C) at 1 atm.

Melting Point: –201.5 to –202.0°F (–129.7 to –130.0°C)

Freezing Point: –201.0 to –201.5°F (–129.4 to –129.7°C)

Molecular Weight: 72.15

Evaporation Rate (butyl acetate=1): 28.6

Heat of Combustion: 46500 kJ/kg

Vapor Pressure: 426 mmHg at 68°F (20°C)

Flash Point: –57°F (–49.4°C), closed cup

Autoignition Temperature: 500 – 588°F (260 – 284°C)

Burning Rate: 8.6 mm/minute

Flammable (Explosive) Limits: 1.5% (LEL) – 7.8% (UEL)

Stability: Stable

Polymerization Potential: Will not occur

pH: Not applicable

Corrosiveness: Will attack some forms of plastics, rubbers and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Expected to react with chlorine, fluorine, halogens and strong oxidizers.

IDENTIFICATION

Shipping Name(s): Pentanes (USDOT); Pentanes, liquid (IMO)

Synonyms and Tradenames: Normal pentane; n-Pentane; Amyl hydride; Skellysolve

CAS Registry No.: 109-66-0

Chemical Formula: $CH_3(CH_2)_3CH_3$

Constituent Components (% each): Over 98% pure with small amounts of other hydrocarbons.

UN/NA Designation: UN1265

IMO Designation: 3, flammable liquids

RTECS Number: RZ9450000

NFPA 704 Hazard Rating: 1 (Health): 4 (Flammability): 0 (Instability)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid, gas above 97°F

Color of the Shipped Material: Colorless

Odor Characteristics: Like gasoline or petroleum

Common Uses: Fuel component and additive; mfg. of amyl chlorides and other chemicals; used as general solvent and for solvent extraction; component of aerosol propellants; blowing agent for plastic foams.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PENTANE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies widely from 2.2 – 400 ppm, therefore, caution should be used in relying on odor alone as a warning of potentially hazardous exposures.

Unusual Hazards: Pentane is highly volatile and flammable with heavier than air vapors that may travel to a source of ignition and flash back. It boils at high ambient temperatures. Vapors may persist for a time in pits, hollows and depressions. Flowing product may be ignited by self-generated static electricity.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TWA): 120 ppm (350 mg/m^3) (NIOSH); 1000 ppm (2950 mg/m^3) (OSHA)

Ceiling (C) Limit: 610 ppm (1800 mg/m^3) (NIOSH)

IDLH: 1500 ppm (10% LEL)

Conditions to Avoid: Heat, fire, and sparks; runoff to water or sewers; inhalation of high concentrations in air; contact with strong oxidizers.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of relatively high vapor concentrations in air. Pentane may be a weak cardiac sensitizer of the heart to epinephrine.

Hazards of Skin or Eye Contact: Repeated or prolonged skin contact with liquid pentane may result in drying and cracking of the skin due to the defatting action of the product. Contact of liquid pentane with the eyes may cause severe irritation, redness, tearing and blurred vision.

Hazards of Inhalation: Exposure to appreciable vapor concentrations may cause irritation of the eyes and respiratory tract. Very high pentane concentrations in air may cause narcosis involving drowsiness, fatigue, nausea, headache, possible loss of consciousness and even death.

Hazards of Ingestion: Ingestion may result in gastrointestinal irritation, nausea, vomiting, and diarrhea. Aspiration into the lungs during vomiting may cause delayed chemical pneumonia and/or pulmonary edema with possibly severe consequences. There is the possibility that pentane will vaporize when swallowed causing aspiration into the lungs, resulting in a rapid fall in oxygen saturation with asphyxia resulting in brain damage or cardiac arrest.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 1.5%

Upper Flammable (Explosive) Limit: 7.8%

Behavior in Fire: Flammable liquid. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. There is some known potential for unconfined vapor clouds of pentanes to explode if ignited.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

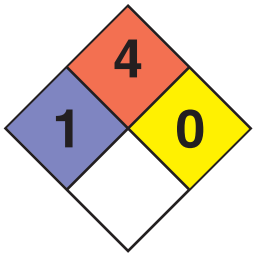
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with pentane. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: Viton®; Nitri Solve 727® gloves; Viton 890® gloves, 4H® and Silver Shield® brand gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Nitrile rubber (gloves, suits, boots); Polyvinyl alcohol (gloves).

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1500 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 1500 ppm): any supplied-air respirator operated in a continuous-flow mode; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece. For lesser concentrations (below 1200 ppm), a supplied-air respirator

1265

PENTANE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Vapor exposure may cause eye and nose irritation, drowsiness, fatigue, nausea, headache and other effects. Contact with liquid pentane may cause dry cracked skin or eye irritation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 20 minutes. Get medical attention immediately if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water and administer large quantities of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Regular foam, carbon dioxide, dry chemical or water spray or fog. Water may be ineffective, other than for cooling containers.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Pentane may float on water. Do not use direct stream of water as product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable vapors. Note that pentane has a flash point of –57°F.

SPILL RESPONSES

General Information: Pentane is a highly flammable and volatile liquid that may cause environmental contamination even though it is expected to biodegrade to a moderate extent when released into the soil or water. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of pentane may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that pentane is a highly flammable substance that may evaporate rapidly and float on water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

PENTANE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Pentane may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of pentane in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to pentane vapors or fumes may accelerate their dispersal in the atmosphere. Pentane may float on water. Do not use direct stream of water as product may be carried across water surface spreading fire or carrying product to source of ignition. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Water runoff may contain a small amount (if any) of pentane from contact with airborne vapors or fumes.

MITIGATION

Where important water sources are threatened, contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of pentane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . . Pentane may be contained by building dikes or barriers using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained pentane may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

PENTANE

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

PENTANE
Class 3 (Flammable Liquid)

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across steam and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled products.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating pentane.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with pentane may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Note that pentane is practically insoluble and, therefore, it is likely that not much has dissolved.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

September 1992

PERCHLORYL FLUORIDE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Perchloryl fluoride is a sweet smelling, toxic, noncombustible, and colorless gas that is typically shipped as a liquid under pressure in gas cylinders or possibly larger containers. Liquid perchloryl fluoride is practically insoluble in water and heavier. Due to its low boiling point temperature of about – 52°F, any spilled liquid will boil or otherwise rapidly vaporize in most cases. Thus, discharges on land or water have the potential to generate large amounts of cold vapor that is heavier than air, that may accumulate and persist in low areas, and that may appear white at first due to condensation of water vapor in air. Containers of the product may rupture violently due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The liquid product weighs approximately 12 pounds per gallon at room temperatures.

Perchloryl fluoride is stable in transportation and does not react with water. Although it is noncombustible, the product is a very strong oxidizer that is reported comparable to oxygen in strength and that will actively initiate or support the burning or explosion of numerous materials.

Contact with liquid perchloryl fluoride or very cold gas streams may result in frostbite and possibly chemical burns. Perchloryl fluoride gas or vapor is highly toxic by inhalation. Exposure to high temperatures can cause the product to decompose and evolve highly toxic and corrosive gases and fumes including such substances as hydrogen fluoride, hydrofluoric acid, and chlorine. Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, and weather conditions if perchloryl fluoride is leaking from its container.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.06 g/100 g water at 77°F (25°C).

Solubility in Other Chemicals: Not available

Specific Gravity (Liquid): 1.434 at 68°F (20°C)

Boiling Point: –52.2 to –51.7°F (–46.8 to –46.5°C) at 1 atm.

Melting Point: – 233.9 or – 230.8°F (–147.7 or –146°C); reported values vary.

Freezing Point: See melting point

Molecular Weight: 102.46

Heat of Combustion: Not combustible

Vapor Pressure: 10.49 atm (154.1 psia) at 68°F (20°C); 5.72 atm (83.98 psia) at 32°F (0°C).

Flash Point: Not combustible

Autoignition Temperature: Not combustible

Burning Rate: Not combustible

Stability: Stable when dry (anhydrous) in steel containers.

Corrosiveness: Many gasketing materials are embrittled by long contact with the gas and the product is known to attack some forms of plastics, rubber, and coatings. Teflon and Kel-F are reported to be unaffected. It is probably prudent to remove all oil, grease, and other combustible materials from piping systems and containers before putting them into service.

Reactivity with Water: No reaction, but contact of very cold liquid perchloryl fluoride with water may result in vigorous boiling and extremely rapid vaporization of the product due to the large temperature differences involved. Pressures may build to dangerous levels if this occurs in a closed container.

Reactivity with Other Chemicals: Perchloryl fluoride is a strong oxidizing material with "power" comparable to liquid or gaseous oxygen. Contact with combustible or oxidizable substances may variably result in fire or formation of substances that may explode if ignited by a spark or flame or subjected to heat, impact, or shock. Contact of the gas or liquid with oxidizable materials of high specific surface area such as carbon, charcoal, lampblack, sawdust, cloth, paper, etc., may result in spontaneous ignition. Exercise extreme caution until explosive shock and heat sensitivity has been determined before handling a material with which perchloryl fluoride may have had contact. Seek additional information from qualified experts on the interaction of the product in question with specific substances where necessary.

IDENTIFICATION

Shipping Names: Perchloryl fluoride

Synonyms and Tradenames: Chlorine fluoride oxide; chlorine oxyfluoride; and trioxychlorofluoride.

Chemical Formula: $\text{Cl-O}_3\text{-F}$

Constituent Components (% each): As best as can be determined, based on data from one maker of the product, perchloryl fluoride shipments are often at least 98.5% pure on a molar basis.

49 STCC: 49 203 45

UN/NA Designation: UN3083

IMO Designation: 2.3, poison gas

Physical State As Shipped: Compressed liquefied gas

Physical State As Released: Boiling liquid, vaporizing liquid, gas, or mixture or gas and aerosols (small liquid droplets) depending on environmental and release conditions; the normal boiling point of perchloryl fluoride is about –52°F.

Color of the Shipped Material: Colorless gas that may appear white at first due to condensation of water vapor from air; color of liquid not available.

Odor Characteristics: Sweet

Common Uses: Making fluorinated organic compounds, fuel cells, and explosives; oxidizing agent in rocket and other fuels; used in flame photometry analyses; used in metal processing and as a gaseous dielectric (i.e., insulator).

PERCHLORYL FLUORIDE
Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at levels as low as 10 ppm in air.

Unusual Hazards: Strong oxidizer that is highly reactive with a wide variety of substances when a sufficiently concentrated gas in air or when in liquid form. Not itself combustible but will support and accelerate the burning of combustible materials. Some substances that do not burn in air may possibly burn in perchloryl fluoride. Similarly, a violent reaction and explosion may possibly occur if liquid perchloryl fluoride is spilled on asphalt or other surfaces contaminated with combustibles (such as oil-soaked concrete or gravel) and the surface is then subjected to impact or shock; do not roll equipment over such surfaces until they are declared safe. Many common clothing materials exposed to concentrated perchloryl fluoride in air or the liquid product may be ignited or caused to explode. Vapors are heavier than air and may persist in low lying areas. Drains may become plugged and valves or pressure relief devices may become inoperable because of the formation of ice due to expanding vapors or vaporizing liquids, particularly in the presence of moisture or water.

Short Term Exposure Limit (STEL): 6 ppm for 15 minutes (ACGIH, 1991–92; OSHA, 1989).

Time Weighted Average (TWA) Limit: 3 ppm over each 8 hours of a 40 hour work week (ACGIH, 1991–92; OSHA, 1989).

Conditions to Avoid: Heat, fire, or sparks; contact with combustible, oxidizable, reactive or otherwise incompatible materials; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high gas or vapor concentrations that may be present in air in the immediate vicinity and over considerable downwind distances from a discharge. Direct contact with liquid perchloryl chloride, very cold gas, or very cold equipment surfaces may cause frostbite and other types of burns.

Hazards of Skin or Eye Contact: Prolonged contact of liquid perchloryl fluoride with the skin may result in moderately severe burns and that some amounts may be absorbed through the skin. Contact with liquid perchloryl fluoride or its very cold gas may cause frostbite, freeze burns, and possibly other burn-like injuries of the skin or eyes due to the cold temperatures involved as well as the strong oxidizing properties of the substance. Be advised and take heed that there is potential for some common clothing materials exposed to a concentrated perchloryl fluoride atmosphere or contaminated with the liquid product to be subject to ignition and accelerated burning or explosion, thus potentially causing serious injury to the wearer of the clothing. It is prudent to remove exposed clothing immediately and not use it or handle it haphazardly until it has been declared safe by a qualified expert.

Hazards of Inhalation: Brief inhalation of perchloryl fluoride is known to cause irritation of the upper respiratory tract in man. Severe exposures may lead to cyanosis evidenced by bluish discoloration of the lips, nose, earlobes and possibly skin, as well as drowsiness, weakness, dizziness, rapid heart beat, nausea, headache, shortness of breath, unconsciousness, convulsions, and possibly death in severe cases.

Hazards of Ingestion: Due to its low boiling point temperature, ingestion of liquid perchloryl fluoride is considered highly unlikely. If it should occur, frostbite and possibly burns of the lips, mouth, and other contacted tissues may be expected (at the very least).

FIRE HAZARDS

Lower Flammable Limit: Not combustible

Upper Flammable Limit: Not combustible

Behavior in Fire: Strong oxidizer. Will support and may greatly intensify a fire upon release. Containers may rupture violently in a fire due to overpressurization. Some substances that do not burn in air may possibly burn in a perchloryl fluoride enriched atmosphere if ignited. Contact of liquid perchloryl fluoride with various fuels and combustible materials may result in an explosion at elevated temperatures or upon ignition. Ignition of various substances in a perchloryl fluoride enriched atmosphere may also possibly result in an explosion.

Hazardous Combustion Products: *Toxic* and corrosive gases such as hydrogen fluoride and chlorine may form when perchloryl fluoride decomposes. Hydrogen fluoride gas may combine with moisture in air to form hydrofluoric acid. Measurable decomposition rates are reported to occur at temperatures above about 880°F (470°C).

3083

PERCHLORYL FLUORIDE
Division 2.3 (Poison Gas)

EXPLOSION HAZARDS

Lower Explosive Limit: Not combustible
Upper Explosive Limit: Not combustible
Explosiveness: Mixtures or reactions of liquid perchloryl fluoride or concentrated perchloryl fluoride gas with a wide variety of materials are subject to explosion under appropriate conditions. Containers may rupture violently due to overpressurization when in a fire or when exposed to excessive heat for sufficient time duration.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent eye contact with liquid perchloryl fluoride or very cold gas streams and should prevent the skin from becoming frozen or burned from contact with the product or cold containers. Clothing and equipment should be of a type that will not freeze to skin and will not ignite on contact with liquid perchloryl fluoride or be subject to ignition and burning in a perchloryl fluoride enriched atmosphere. By analogy to recommendations for oxygen, preferred materials are those with smooth surfaces which prevent accumulation of the product; they should be clean, oil free, and insulated as necessary. Fully encapsulating suits with self-contained breathing apparatus (SCBA) are recommended by the U.S. Department of Transportation in its 1990 Emergency Response Guidebook for use under emergency conditions where perchloryl fluoride has been or has the potential to be discharged. Note that many types of regular (i.e., daily wear) clothing materials and possibly some types of protective clothing materials may be subject to reaction with perchloryl fluoride and possible ignition or explosion under appropriate conditions. Remove such contaminated clothing and do not reuse until it has been declared safe by a qualified expert. Seek the advice of qualified experts with respect to suitable protective clothing materials where possible and/or make every attempt to minimize the exposure of the clothing to perchloryl fluoride.
Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Gas masks or cartridge type respirators containing activated carbon or charcoal should never be used since the carbon may ignite spontaneously or adsorb perchloryl fluoride and become explosive in atmospheres containing high concentrations of perchloryl fluoride vapor or gas.

FIRST AID

Nonspecific symptoms: Frostbite or burns of the skin, eyes, or other bodily tissues; cyanosis, drowsiness, weakness, dizziness, rapid heart beat, nausea, headache, shortness of breath, and other signs of exposure.
First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing or immediately if not frozen. Wash affected body areas with large amounts of warm water. Get medical attention immediately if irritation, burns, or frostbite are apparent after washing. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming if warm water is not available. Handle potentially contaminated oxidizable clothing with caution when appropriate due to the possibility of its ignition or explosion.
First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately. Do not use hot water or rub frozen areas.

PERCHLORYL FLUORIDE
Division 2.3 (Poison Gas)

FIRE RESPONSE

Extinguishing Materials: Do not use dry chemicals, carbon dioxide, or halons where they may contact perchloryl fluoride. Use water on small fires. Otherwise, contain and let fire burn. If fire involving the product must be fought, water spray or fog is recommended. (Note: In the absence of more detailed and specific information, these recommendations were extracted from the U.S. DOT 1990 Emergency Response Guidebook.)

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit of compatible material if contact with material or dense fumes/smoke is anticipated. Move container from fire area if no risk. Stop flow of perchloryl fluoride if safe to do so before attempting to extinguish fire unless the appropriate extinguishing techniques for burning materials indicate that the fire should not be extinguished until other fuel flows are stopped. Be alert to the possibility that the container of perchloryl fluoride may tear or rupture and suddenly release massive amounts of the product (which may greatly magnify the fire) when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of a tank due to fire. Avoid direct application of water on safety relief devices fitted to liquid perchloryl fluoride containers if possible, since resultant cold exposure may cause ice to form, thus preventing proper functioning of the devices. When large pools of water-soluble fuels are present, consider using water (if safe to do so) to dilute the fuel and to reduce the intensity of the fire. When a non-water soluble fuel and liquid perchloryl fluoride are mixed or mixing but are not yet burning, isolate the area from sources of ignition and get out quickly, allowing the perchloryl fluoride to evaporate. Before isolating and handling materials with which perchloryl fluoride has or may have reacted, be they organic or inorganic in nature, exercise extreme caution until the potential explosive shock and heat sensitivity of the material has been determined. Note that contact with water may increase vapor evolution from any pools of liquid perchloryl fluoride that may form on the ground. (Note: Many of the more unusual recommendations above were extracted from procedures recommended for response to incidents involving oxygen.)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Choose equipment that is not damaged by the spilled product and that is suitable for perchloryl fluoride service. Where necessary, use spark-proof and explosion-proof tools and equipment, eliminate ignition sources, and ground all equipment and transfer lines prior to use. Seek expert advice before transferring perchloryl fluoride from its container to a second container. Ensure that the receiving container has been specially designed and cleaned to receive the product. Never transfer liquid perchloryl fluoride where it may spill onto gravel or another porous material that may contain oil drippings. Areas where liquid may be spilled during transfer operations must be free of hydrocarbons (including asphalt) or other combustible materials. In the event liquid is spilled on asphalt or other surfaces contaminated with combustibles (such as oil-soaked concrete or gravel), do not walk on or roll equipment over the area for some time, since there is potential for a violent reaction or explosion to occur simply by impact or shock. Open any valves on equipment slowly to avoid possible ignition of particles carried by perchloryl fluoride flowing at high velocity. Take the high volatility and many unusual properties and hazards of perchloryl fluoride into account while planning the response. Beware of possible heavy gas accumulations in low areas. (Note: In the absence of more specific information, many of these precautions are those commonly recommended for handling liquid or compressed oxygen and may not be fully necessary or appropriate for perchloryl fluoride.)

PERCHLORYL FLUORIDE
Division 2.3 (Poison Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Perchloryl fluoride discharges may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to perchloryl fluoride gas or vapor in air may accelerate its dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid perchloryl fluoride pools with water spray or fog may increase gas evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid perchloryl fluoride.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid perchloryl fluoride may be contained by building dikes or barriers using dry sand or other compatible materials where conditions permit this action to be safely undertaken. Storm drains and sewer openings may be protected using similar methods.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product where conditions permit this action to be safely undertaken.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may possibly be recovered using appropriate hoses, pumps and storage containers. Any remaining traces of perchloryl fluoride on the ground will vaporize fairly quickly.

CONSEQUENCE

Equipment that is incompatible with the spilled product and/or not suitable for liquid perchloryl fluoride service may become damaged, develop leaks, or rupture or explode. Very high pressures may develop in equipment.

MITIGATION

Use compatible and appropriate equipment of proper pressure capacity. Consider precooling the equipment with cold nitrogen gas before initiation of full scale recovery of the liquid to avoid high initial vaporization rates upon entry of the product into the equipment. Ensure that the equipment is sufficiently clean for use with a strong oxidizer. Consult qualified experts for guidance.

WATER SPILL

Liquid perchloryl fluoride will boil or rapidly vaporize from the surface of a water body with very little dissolution if any in the majority of cases.

PETROLEUM CRUDE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Petroleum crude oil is a flammable, variably light to dark colored liquid hydrocarbon with properties between gasoline and kerosene. It is used as a raw material for making fuels and various chemicals. Barely soluble in water and slightly lighter, petroleum crude oil will form a floating surface slick. Flammability of this product can vary widely having a flash point range from -45 to 392ºF. The liquid may evaporate easily even at low temperatures. The vapors of the more volatile, and therefore more flammable crude oil, are heavier than air, may accumulate and persist in low areas, and may travel some distance to a source of ignition and flash back. Similarly, accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited and there is some potential that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. Typical crude oil weigh approximately 6.3-8.3 pounds per gallon.

Petroleum crude oil will not react with water or other common materials and is stable in normal transportation. It is incompatible with strong oxidizers, and may attack some forms of plastics, rubber, and coatings. Toxicity by potential routes of exposure is generally considered low to moderate. The more volatile mixtures may be present in air in high concentrations creating an inhalation hazard. There is also the possibility that the crude oil may contain some fraction of toxic benzene or hydrogen sulfide (see separate guides). Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, below 0.1%

Solubility in Other Chemicals: Soluble in various hydrocarbon liquids.

Specific Gravity (Liquid): Varies, 0.75 - 0.99

Vapor Density: 3.4 (approximately)

Boiling Point: Varies, 1000+ºF (538+ºC).

Melting Point: Unavailable

Freezing Point: Unavailable

Molecular Weight: Complex mixture, approximately 99

Heat of Combustion: 10,290 - 10,460 cal/g (Petroleum distillates)

Evaporation Rate (butyl acetate=1): 10 (approximately)

Vapor Pressure: Varies widely with composition, 40 mmHg for petroleum distillates.

Flash Point: Varies widely -45 to 392ºF (-43 to 200ºC)

Autoignition Temperature: 450 - 500ºF (232 - 260ºC)

Burning Rate: 4 mm/minute

Flammable Limits: 0.4% (LEL) - 15% (UEL)

Stability: Stable

Polymerization Potential: Will not occur.

Corrosiveness: Relatively noncorrosive but may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with strong oxidizing materials. Avoid chlorine, fluorine.

IDENTIFICATION

Shipping Name(s): Petroleum crude oil (USDOT & IMO).

Synonyms and Tradenames: Crude oil ; Mineral oil; Rock oil; Coal oil; Petroleum.

CAS Registry No.: 8002-05-9

Chemical Formula: C_6-C_{13} hydrocarbon mixture. Crude oil is a naturally occurring complex mixture of hydrocarbons whose exact composition and physical properties can vary widely depending upon its source.

Constituent Components (% each): Complex mixture of petroleum hydrocarbons; may contain 0-10% benzene.

UN/NA Designation: UN1267

IMO Designation: 3.1, 3.2 or 3.3, Flammable liquids

NFPA 704 Hazard Rating: 2(Health): 3(Flammability): 0(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Dark yellow to brown or greenish-black, oily liquid.

Odor Characteristics: Like gasoline and kerosene

Reportable Quantity: See appendix I.

Common Uses: Raw material for making fuels and various chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PETROLEUM CRUDE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies

Unusual Hazards: Properties uncertain. Vapors of some crude oil may be heavier than air and may travel to a source of ignition. Some may include significant amounts of benzene (see separate guide).

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 86 ppm (350 mg/m^3) (Petroleum distillates).

Ceiling (C) Limit: 444 ppm (1800 mg/m^3) (Petroleum distillates).

IDLH: 1100 ppm or 10% LEL (Petroleum distillates).

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air. Ingestion and direct contact are also to be avoided. (Note: Any benzene in the product increases both acute and chronic health risks.)

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid petroleum crude oil may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Contact with the eyes may result in irritation and possibly temporary corneal injury.

Hazards of Inhalation: Vapors of petroleum crude oil may be irritating to the eyes and the upper respiratory tract. High concentrations in air may result in narcosis and central nervous system depression with symptoms including inebriation, headache, nausea, dizziness, drowsiness, unconsciousness, convulsions, and possibly death. Some symptoms may be evident after 1 hour at 4000-7000 ppm in air. Acute overexposure may also result in persistent anorexia and nervousness on occasion.

Hazards of Ingestion: Ingestion may cause a burning sensation, vomiting, diarrhea, drowsiness, and symptoms listed above. Aspiration into the lungs during vomiting may result in pulmonary edema with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 0.4%

Upper Flammable Limit: 15%

Behavior in Fire: Flammable liquid. Liquid will burn but may be difficult to ignite depending on constituents. Flammable liquids may generate large quantities of flammable vapor upon release. Vapors of flammable liquids are heavier than air, may accumulate and persist in low areas, and may travel to a source of ignition and flash back. There is some potential that containers may rupture violently in fire.

Hazardous Decomposition Products: Not well-defined, may include toxic constituents such as carbon monoxide, carbon dioxide, oxides of sulfur and reactive hydrocarbons.

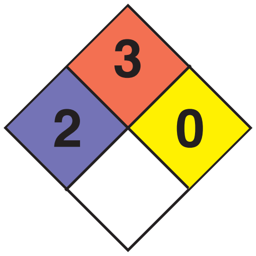
EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire. Product is sensitive to static discharge and is an extreme fire hazard. Vapors can burn with explosive violence.

1267

PETROLEUM CRUDE OIL

Class 3 (Flammable Liquid) or
Combustible Liquid



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, chlorinated polyethylene, polyurethane, polyvinyl alcohol, Viton®, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Eye Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

Note to Physician: Hydrocarbons may sensitize the heart to epinephrine and other circulating catecholamines so that arrhythmias may occur. Careful consideration of this potential adverse effect should precede administration of epinephrine or other cardiac stimulants and the selection of bronchodilators.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam, or water spray. Water may be ineffective and there is some possibility that foam or water may cause some frothing.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note: Crude oil fires may produce a highly dangerous phenomenom known as a BOILOVER, whereby light hydrocarbons burn off at the surface of the fire and heavy superheated hydrocarbons sink to the bottom and come in contact with water bottoms. The super heated product converts the water to steam and forces burning crude oil out of the tank. Burning crude oil which has accumulated in tanks or diked areas are susceptible to boilovers. Seek expert advice on how to fight a crude oil fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of petroleum crude oil may result in rupture or explosion of boilers or industrial process equipment. Use intrinsically safe equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the specific flammability hazard and possible volatility of the spilled product into account while planning the response.

PETROLEUM CRUDE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to petroleum crude oil vapors or fumes may accelerate their dispersal in the atmosphere. (Note: There is some possibility that water may cause frothing.)

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of petroleum crude oil from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of petroleum crude oil vapors into the atmosphere. (Note: There is some possibility that foam may cause frothing.)

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Petroleum crude oil may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined petroleum crude oil may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination if some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

PETROLEUM CRUDE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

PETROLEUM CRUDE OIL
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating petroleum crude oil.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with petroleum crude oil may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

September 2000

PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Petroleum distillates are flammable, colorless to variably colored liquid hydrocarbon mixtures with properties between gasoline and kerosene. They are used in cleaning preparations, as a solvent, and as a raw material for making various chemicals. Barely soluble in water and lighter, petroleum distillates will form a floating surface slick. Flammability of these products can vary widely with flammable liquids having flash points below 100ºF and combustible liquids having flash points in the range of 100-199ºF. Liquid evaporates easily even at low temperatures. The vapors of the more volatile, and therefore more flammable distillates, are heavier than air, may accumulate and persist in low areas, and may travel some distance to a source of ignition and flash back. Similarly, accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited and there is some potential that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. Typical distillates weigh approximately 6.1-6.3 pounds per gallon.

Petroleum distillates do not react with water or other common materials and are stable in normal transportation. They are incompatible with strong oxidizers, and may attack some forms of plastics, rubber, and coatings. Toxicity by potential routes of exposure is generally considered low to moderate. The more volatile mixtures may be present in air in high concentrations creating an inhalation hazard. There is also the possibility that the distillates may contain some fraction of toxic benzene (see separate guide). Products of combustion may include toxic constituents.

Downwind evacuation should be considered on a case by case basis if a significant amount of highly volatile petroleum distillates is leaking but not on fire. Naphtha is the predominant material transported under this USDOT description.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, approx. 0.04 g/100 g water at 68ºF (20ºC)

Solubility in Other Chemicals: Soluble in various hydrocarbon liquids.

Specific Gravity (Liquid): Varies, 0.63 - 0.76 at 59ºF (15ºC)

Vapor Density: 3.4 (approximately)

Boiling Point: Varies, 86 - 284ºF (30 - 140ºC) or higher.

Melting Point: Varies, -100 to -30ºF (-73.3 to -34.4ºC)

Freezing Point: Varies, approximately -99ºF (-72.7ºC)

Molecular Weight: Complex mixture, approximately 99

Heat of Combustion: 10,290 - 10,460 cal/g

Evaporation Rate (butyl acetate=1): 10 (approximately)

Vapor Pressure: Varies widely with composition, approximately 40 mmHg.

Flash Point: Varies, approximately -40 to over 100ºF (-40 to over 38ºC)

Autoignition Temperature: 450 - 500ºF (232 - 260ºC)

Burning Rate: 4 mm/minute

Flammable Limits: 1.1% (LEL) - 5.9% (UEL)

Stability: Stable

Polymerization Potential: Will not occur.

Corrosiveness: Relatively noncorrosive but may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with strong oxidizing materials.

IDENTIFICATION

Shipping Name(s): Petroleum distillates, n.o.s. or Petroleum products, n.o.s. (USDOT & IMO).

Synonyms and Tradenames: Petroleum naphtha; Aliphatic petroleum naphtha; Petroleum ether; Naphtha; Petroleum. Other possibilities include light ligroin, rubber solvent, and Benzine.

CAS Registry No.: 8002-05-9 or 70592-78-8

Chemical Formula: C_6-C_{13} hydrocarbon mixture

Constituent Components (% each): Complex mixture of petroleum hydrocarbons; may contain 0-10% benzene.

UN/NA Designation: UN1268

IMO Designation: 3.1, 3.2 or 3.3, Flammable liquids

RTECS Number: SE7449000

NFPA 704 Hazard Rating: 2(Health): 3(Flammability): 0(Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless to variably colored

Odor Characteristics: Like gasoline and kerosene

Reportable Quantity: See appendix I.

Common Uses: Industrial solvent; component of cleaning preparations; raw material for making various chemicals.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies

Unusual Hazards: Properties uncertain. Vapors of some distillates may be heavier than air and may travel to a source of ignition. Some may include significant amounts of benzene (see separate guide).

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 86 ppm (350 mg/m^3)

Ceiling (C) Limit: 444 ppm (1800 mg/m^3)

IDLH: 1100 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air. Ingestion and direct contact are also to be avoided. (Note: Any benzene in the product increases both acute and chronic health risks.)

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid petroleum distillates may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Contact with the eyes may result in irritation and possibly temporary corneal injury.

Hazards of Inhalation: Vapors of petroleum distillates may be irritating to the eyes and the upper respiratory tract. High concentrations in air may result in narcosis and central nervous system depression with symptoms including inebriation, headache, nausea, dizziness, drowsiness, unconsciousness, convulsions, and possibly death. Some symptoms may be evident after 1 hour at 4000-7000 ppm in air. Acute overexposure may also result in persistent anorexia and nervousness on occasion.

Hazards of Ingestion: Ingestion may cause a burning sensation, vomiting, diarrhea, drowsiness, and symptoms listed above. Aspiration into the lungs during vomiting may result in pulmonary edema with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 0.9-1.2%

Upper Flammable Limit: 6-7%

Behavior in Fire: Flammable or combustible liquid. Combustible liquids will burn but may be difficult to ignite. Flammable liquids may generate large quantities of flammable vapor upon release. Vapors of flammable liquids are heavier than air, may accumulate and persist in low areas, and may travel to a source of ignition and flash back. There is some potential that containers may rupture violently in fire.

Hazardous Decomposition Products: Not well-defined, may include toxic constituents such as carbon monoxide, carbon dioxide, oxides of sulfur and reactive hydrocarbons.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire. Product is sensitive to static discharge and is an extreme fire hazard. Vapors can burn with explosive violence.

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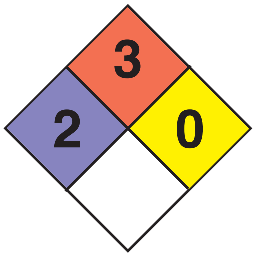
PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid



PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, chlorinated polyethylene, polyurethane, polyvinyl alcohol, Viton®, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10,000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge (10,000 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Eye Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

Note to Physician: Hydrocarbons may sensitize the heart to epinephrine and other circulating catecholamines so that arrhythmias may occur. Careful consideration of this potential adverse effect should precede administration of epinephrine or other cardiac stimulants and the selection of bronchodilators.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam, or water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of petroleum distillates may result in rupture or explosion of boilers or industrial process equipment. Use intrinsically safe equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the specific flammability hazard and volatility of the spilled product into account while planning the response.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of petroleum distillates from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Petroleum distillates may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination if some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S.

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER UNDER FLOW DAMS . . . Streams may be provided with an under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating petroleum distillates.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with petroleum distillates may be used to absorb spilled product from the water surface, preferably after the spill has been confined.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

September 2006

PETROLEUM GAS, LIQUEFIED

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Liquefied petroleum gas, or LPG as it is commonly known, is a colorless, highly flammable mixture of hydrocarbon gases that is shipped as a liquid under pressure. It is odorless and colorless in its natural state, but a commercial odorant is added prior to delivery at bulk plants so it can be detected down to a concentration of air not over 20% of the Lower Explosive Limit. It is used primarily as a fuel but also has uses as a chemical industry feedstock, as an aerosol propellant, and in making synthetic rubber. It is essentially insoluble in water and lighter. Due to its low boiling point, any spilled liquid will boil or otherwise rapidly vaporize to produce large amounts of heavier than air vapors and gases that may accumulate and persist in pits, hollows, and depressions. Vapors may also travel considerable distances to a source of ignition and flash back or even explode. Accumulations in confined spaces such as buildings or sewers may explode if ignited, and containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. There is at least one case where a damaged but non-leaking container ruptured violently in the absence of heat or fire during railroad wreck clearing operations. The liquid weighs approximately 4.3 – 4.8 pounds per gallon near its boiling point.

LPG does not react with water or many other common materials, and is primarily incompatible with oxidizing materials that may cause its ignition. Toxicity of the product is low, but contact may result in frostbite or irritation and inhalation of high vapor concentrations in air may be harmful. Products of combustion may include toxic constituents.

If LPG is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 330 feet (100 meters) in all directions. If the spill is large, consider initial downwind evacuation of one-half (1/2) mile (800 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one mile (1600 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Essentially insoluble
Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform and ether.
Specific Gravity (Liquid): 0.51 – 0.61 at –58°F (–50°C)
Vapor Density: 1.52
Boiling Point: –54.4 to 31.1°F (–48 to –0.5°C) at 1 atm.
Melting Point: Very low
Freezing Point: –306°F (–188°C)
Molecular Weight: 42 – 58 (depends on mixture)
Heat of Combustion: –10990 cal/g
Evaporation Rate: Rapid
Vapor Pressure: As much as 8.6 atm (126.3 psia) at 68°F (20°C); 3725 mmHg at 95°F (35°C)
Flash Point: –153°F (–103°C)
Autoignition Temperature: 761 – 842°F (405 – 450°C)
Burning Rate: 8.2 mm/minute
Flammable (Explosive) Limits: 1.9%, 2.1% (LEL) – 8.5%, 9.5% (UEL) (butane, propane)
Stability: Stable
Polymerization Potential: Will not occur
pH: Not applicable
Corrosiveness: Relatively non-corrosive, but may attack some forms of plastics, rubber and coatings.
Reactivity with Water: No reaction
Reactivity and Incompatibility: Reacts with nitric acid, chlorine dioxide and strong oxidizing materials.

IDENTIFICATION

Shipping Names: Liquefied petroleum gas (USDOT & IMO)
Synonyms and Tradenames: LPG; Bottled gas; Pyrofax; Compressed petroleum gas; Liquefied hydrocarbon gas; Odorized propane; Propane motor fuel
CAS Registry No.: 68476-85-7
Chemical Formula: Propane (C_3H_8); butane (C_4H_{10}) propylene (C_3H_6)
Constituent Components (% each): Can be propane, butane, propylene, isobutant or isobutylene or mixtures of each, with possibly some small amount of odorant.
UN/NA Designation: UN1075
IMO Designation: 2.1, flammable gas
RTECS Number: SE7545000
NFPA 704 Hazard Rating: 2 (Health): 4 (Flammability): 1 (Instability). Rating is based on 3 main constituents of butane, propylene and propane. Propane is an asphyxiant.
Physical State as Shipped: Liquid
Physical State as Released: Boiling liquid or gas
Color of the Shipped Material: Colorless, but very cold gas may appear white.
Odor Characteristics: Odorless or mild petroleum odor, but may contain skunk-like odorant.
Common Uses: Fuel gas; chemical feedstock; mfg. of synthetic rubber; aerosol propellant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PETROLEUM GAS, LIQUEFIED

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Varies widely, several source reports 4800 – 20000 ppm, however, even with odorant added, odor is not an adequate indicator of vapor concentration.

Unusual Hazards: Extremely flammable heavier than air gas that may travel considerable distance to a source of ignition. Vapor may persist in low areas. There is some potential that unconfined vapor clouds may explode if ignited.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1000 ppm (1800 mg/m^3) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 2000 ppm (10%LEL)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentrations that may be present in air, but direct contact should also be avoided and may cause frostbite.

Hazards of Skin or Eye Contact: Contact with liquid LPG or cold concentrated gas may cause frostbite as well as irritation.

Hazards of Inhalation: High concentrations of LPG in air may cause central nervous system depression with symptoms including light-headedness, drowsiness, unconsciousness, and possibly death. Very high levels may also cause asphyxiation via displacement of air.

Hazards of Ingestion: Ingestion of LPG is unlikely.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 1.9% (butane) 2.1% (propane)

Upper Flammable (Explosive) Limit: 8.5% (butane) 9.5% (propane)

Behavior in Fire: LPG has an expansion ratio of 1 to 270 and can generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include carbon monoxide, carbon dioxide, nitrogen oxides and toxic constituents.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosions may result if vapors are ignited in a confined area. There is also known potential for explosions involving unconfined vapor clouds.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact with the spilled product and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, nitrile rubber, polyurethane, polyvinyl chloride, Viton®, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2000 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 2000 ppm): any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator.

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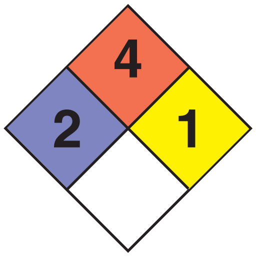
PETROLEUM GAS, LIQUEFIED

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Light-headedness, drowsiness, frostbite, or irritation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of lukewarm water until circulation returns. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination. (Note: Do not use hot water.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Stop flow gas or let large fires burn. Use carbon dioxide or dry chemical on small fires in open. Cooling water should be applied directly on the shell on the burning container so that all sides of the tank are protected. Use of unmanned monitors is preferred to reduce risk of personnel from Boiling Liquid Expanding Vapor Explosion (B.L.E.V.E.).

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water may increase vapor evolution from any pools of liquid LPG on the ground.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Use explosion-proof equipment where necessary. Choose equipment, where possible that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile and flammable nature of LPG into account while planning the response. Beware of possible heavy gas accumulations in low areas.

PETROLEUM GAS, LIQUEFIED

Division 2.1 (Flammable Gas)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . LPG may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of LPG in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Hoselines placed on a narrow fog pattern or spray can help disperse flammable vapors down wind of the leak or spill. Note: Water should ***not*** be applied directly to pooled liquid LPG. It will rapidly increase the rate of vaporization. Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of liquefied petroleum gas from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . LPG may be contained by building dikes using soil, dry sand or other materials.

CONSEQUENCE

Contained LPG may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination. May generate large amounts of vapors which are highly flammable and can be easily ignited.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination and loss of product from vaporization. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials. Make sure there are no sources of ignition near the area of the spill.

PETROLEUM GAS, LIQUEFIED

Division 2.1 (Flammable Gas)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination. May generate large amounts of vapors which are highly flammable and can be easily ignited.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Make sure there are no sources of ignition near the area of the spill.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. High pressures may develop in equipment. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product and of proper pressure capacity. Decontaminate equipment.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination. Note: LPG is expected to vaporize rapidly with negligible dissolution; therefore, there may not be a significant effect.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

This page may be used for notes.

March 1995

PHENYL MERCAPTAN

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Phenyl mercaptan, also shipped with the name “benzenethiol”, is a colorless to light yellow flammable liquid with a repulsive and nauseating odor resembling strong garlic or burnt rubber. It is practically insoluble in water and slightly heavier, so may be expected to sink and dissolve at an extremely slow rate. Its reported flash point range of 123 to 132°F indicates that the substance must be subjected to very high ambient temperatures in its container or somewhat preheated before it can be easily ignited. Under such conditions, phenyl mercaptan vapors may travel some distance to a source of ignition and flash back. Accumulations of vapor from sufficiently warm phenyl mercaptan may explode if ignited in confined spaces such as buildings or sewers. There appears to be some possibility that containers may rupture violently, explode, and/or rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 9 pounds per gallon. Its melting/freezing point temperature range of 5 to 5.4°F indicates it may solidify at cold ambient temperatures.

Phenyl mercaptan does not react with water or many other common materials and is considered stable in normal transportation. Upon exposure to air, it rapidly oxidizes to form unspecified amounts of diphenyl disulfide. In the absence of air, it is reported stable up to a temperature or 392°F. Phenyl Mercaptan is weakly acidic, mildly corrosive to carbon steel, and likely to attack some forms of rubber, plastics, and coatings. The substance poses a high toxic hazard by all routes of exposure but especially via inhalation.

Downwind evacuation or an alternative public protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if phenyl mercaptan is leaking from its container. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of at least one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 470 ppm at 59°F (15°C)

Solubility in Other Chemicals: Very soluble in alcohol, ether, carbon disulfide, and aromatic and aliphatic hydrocarbons.

Specific Gravity (Liquid): 1.075-1.078 at 68°F (20°C)

Boiling Point: 334.4-336.2°F (168-169°C) at 1 atm.

Melting Point: 5.0 to 5.4°F (-15 to -14.8°C)

Freezing Point: See melting point

Molecular Weight: 110.17

Heat of Combustion:Not available

Vapor Pressure: Approx 1.4 mm Hg (0.0271 psia) at 68°F 20°C); 3.4 mm Hg (0.0657 psia) at 104°F (40°C).

Flash Point: 123-132°F (50.6-55.6°C), closed-cup

Autoignition Temperature: Not available

Burning Rate: Not available

Stability: Stable in normal transportation; typically shipped in a nitrogen atmosphere. The product rapidly oxidizes upon exposure to air to form unspecified amounts of diphenyl disulfide. In the absence of air, phenyl mercaptan is reported to be stable up to a temperature of 392°F (200°C).

Corrosiveness: Available information is limited. Liquid phenyl mercaptan is weakly acidic and reported as mildly corrosive to carbon steel. It is also likely to attack some forms of rubber, plastics, and coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reported as incompatible with oxidizing agents; reacts violently with calcium hypochlorite.

IDENTIFICATION

Shipping Names: Phenyl mercaptan (USDOT & IMO)

Synonyms and Tradenames: Mercaptobenzene; phenylthiol; and thiophenol

Chemical Formula: C_6H_5-SH

Constituent Components (% each): Only determined that some commercial grades are 97% or more pure; others are 99% or more pure.

UN/NA Designation: UN2337

IMO Designation: 6.1, poisonous substance

Physical State As Shipped: Liquid

Physical State As Released: Liquid or solid (solidifies at or below 5.4°F)

Color of the Shipped Material: Usually colorless; may be light yellow at times according to one authority.

Odor Characteristics: Penetrating, repulsive, putrid, nauseating and offensive; described as resembling strong garlic or burnt rubber.

Common Uses: Making various pesticides and pharmaceutical products; in solvent formulations for removal of polysulfide sealants in aircraft production and maintenance; as an odorant in natural gas for detection of leaks.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

PHENYL MERCAPTAN

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Detectable at very low concentrations. Various sources list detection levels of 0.0002 ppm, 0.00026 ppm, 0.0094 ppm, and/or 0.022 ppm. Some tolerance to the odor may develop with time. One authority implies a median odor threshold of 13 ppm, which is inconsistent with other available data.

Unusual Hazards: Poisonous liquid by all routes of exposure; low concentrations in air can produce toxic effects or death via inhalation. Odor is foul and detectable at extremely low concentrations according to most sources of information. Indeed, a repulsive odor may be smelled at downwind distances well beyond the zone in which toxic effects may be expected.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: 0.5 ppm over each 8 hours of a 40 hour work week (ACGIH, 1991-92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the high concentrations of phenyl mercaptan that may be present in air in the immediate spill area and over considerable distances downwind. Ingestion and direct physical contact are also to be strictly avoided. Note that the odor of phenyl mercaptan may be detectable and repulsive at downwind distances well beyond those at which toxic effects may be experienced.

Hazards of Skin or Eye Contact: The vapor of phenyl mercaptan is a strong lacrimator and can be severely irritating to the eyes at high concentrations in air. When tested on rabbits, contact of the eyes with liquid phenyl mercaptan caused severe irritation, moderate to severe redness, edema of the ocular conjunctiva, pain, temporary opacity of the cornea causing blurred vision, and discharge. Contact of liquid phenyl mercaptan with the skin can cause severe skin irritation and possibly burns. Absorption of the liquid through the skin can contribute to the toxic effects of phenyl mercaptan and may be fatal in extreme cases. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Vapors of phenyl mercaptan are severely irritating to the nose, throat, airways, and lungs. Symptoms of exposure are variably reported to include restlessness, headache, dizziness, sore throat, laryngitis, a burning sensation in the lungs, coughing, wheezing, shortness of breath, labored breathing, increased respiration, incoordination, muscular weakness or paralysis, lethargy and/or sedation, respiratory depression, nausea, vomiting, spasm, coma, and possibly death. Survivors of a direct exposure may experience delayed pulmonary edema, inflammation and edema of the larynx, and chemical pneumonitis with possibly severe consequences (including death). Repeated exposures of mice to phenyl mercaptan vapors over a relatively short period of time caused systemic effects, kidney damage, fatty degeneration and necrosis of the liver, capillary enlargement, patchy edema, and occasional hemorrhages in the lungs. Exposure to only 28 ppm of phenyl mercaptan in air for 4 hours was sufficient to kill 50% of mice in laboratory experiments; exposure to 34 ppm for the same period of time was fatal to 50% of rats. The saturated vapor concentration directly over a pool of liquid phenyl mercaptan is about 1840 ppm at 68°F and 4475 ppm at 104°F.

Hazards of Ingestion: Ingestion of liquid phenyl mercaptan is variably reported to cause sore throat, severe irritation of the gastrointestinal tract, abdominal pain, nausea, vomiting, dizziness, weakness, and other symptoms similar to those observed from inhalation.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: May require some degree of preheating to be easily ignited. May generate flammable vapors upon release if heated or if released under very high ambient temperature conditions.

Hazardous Combustion Products: Not well-defined; combustion and thermal decomposition products are reported to include carbon monoxide, carbon dioxide, toxic oxides of sulfur (such as sulfur dioxide), highly toxic hydrogen sulfide, and possibly other toxic or irritating constituents.

2337

PHENYL MERCAPTAN

Division 6.1 (Poisonous Material)

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from warm or hot liquid are ignited in a confined area. Despite the high boiling point and low vapor pressure of phenyl mercaptan, there appears to be some potential for containers to rupture violently, possibly rocket, and/or explode in fires. One authority reports that phenyl mercaptan is only stable in the absence of air up to a temperature of 392°F but does not specify the consequences of exposures to higher temperatures.)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. Compatible materials may include polyvinyl alcohol.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5.5 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (for levels of 5.5 ppm or less) or a chemical cartridge respirator with a full or half facepiece and organic vapor cartridge(s) (for levels of 1.1 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation or burns of the eyes, skin, nose, throat, or respiratory system; headache, dizziness, coughing, shortness of breath, incoordination, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately if eye contact has occurred or skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, have victim immediately rinse mouth thoroughly with water and then administer several glasses of water. Do not attempt to make the victim vomit. Get medical attention immediately. If professional medical attention cannot be obtained quickly, then consider inducing vomiting if the victim is conscious and then repeat administration of water. Whether vomiting occurs naturally or is induced, have the victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, foam.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear, rupture or explode, possibly rocket, and/or suddenly release massive amounts of product when exposed to high heat such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take the highly toxic nature of phenyl mercaptan into account when planning the response.

PHENYL MERCAPTAN
Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION ... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Phenyl mercaptan discharges may expose downwind areas to toxic concentrations over considerable distances in some cases. Flammable concentrations will usually exist over lesser distances if the material is heated above its flash point before or after release.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY ... Water fog or spray applied to phenyl mercaptan vapors in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of phenyl mercaptan from contact with its airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM ... There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of phenyl mercaptan vapors into the atmosphere. (Note: The fact that foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution. Authorities disagree as to whether regular or alcohol foam should be applied; both may be effective to some degree.)

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES ... Liquid phenyl mercaptan or contaminated runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained liquid and spread of contamination.

MITIGATION

Removed contained liquid as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

PHENYL MERCAPTAN

Division 6.1 (Poisonous Material)

TECHNIQUE

EXCAVATION ... A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION ... Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Note that phenyl mercaptan will solidify at temperatures at or below 5.4°F and may clog or plug hoses or pumps in cold weather.

MITIGATION

Use equipment compatible with the spilled product. Take the ambient temperature into account when applying this technique.

TECHNIQUE

ABSORPTION ... Spreading of phenyl mercaptan may be controlled by absorbing the liquid with sand, earth, clay, activated charcoal or carbon, dry lime, soda ash, sodium carbonate, vermiculite, commercial sorbents, or other compatible substances according to various authorities. Sand, earth, clay, vermiculite, commercial sorbents, or other compatible materials may also be used to absorb contaminated water runoff.

CONSEQUENCES

Once used, some sorbent materials may pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

NEUTRALIZATION ... Application of an appropriate neutralization agent may modify remaining phenyl mercaptan residues to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL ... Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

PHENYL MERCAPTAN
Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE ... Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Liquid phenyl mercaptan is very slightly soluble in water and only slightly heavier. Though it may first travel some distance downstream, most authorities presume that the liquid will eventually sink to the bottom of a body of water and dissolve at a very slow rate. There is a possibility, however, that the phenyl mercaptan may remain suspended in the water column as various size droplets for quite some time in natural water bodies that are not completely pure. Be advised that a concentration as low as 0.000062 ppm of phenyl mercaptan by weight will impart a faint odor to the water. Higher levels may result in stronger odors.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT ... Spilled product may sink in water at some rate. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination where possible.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING ... Stream or lake beds may be dredged to remove heavier-than-water spilled products that have settled on the bottom and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES ... Water with dissolved or suspended chemicals may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

CHEMICAL TREATMENT ... Application of appropriate chemical agent(s) to the body of water containing dissolved or suspended chemicals and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

March 1995

PHOSGENE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Phosgene is a colorless to light yellow liquefied compressed poison gas with a boiling point in the range of 45.7-46.8°F and an odor that resembles freshly mown grass or musty hay in low concentrations and becomes sharp and pungent at higher levels. It is used in metallurgy and in the making of various chemicals, and was once used as a poison gas by the military. The product is very slightly soluble in water, slowly reactive (see below) and somewhat heavier, so may be expected to simultaneously boil, sink, and/or react in water with its specific actions depending upon the water temperature and depth of release. It weighs approximately 11.8 pounds per gallon.

Phosgene reacts slowly with water to form corrosive but far less toxic hydrogen chloride or hydrochloric acid together with carbon dioxide and is considered to be stable in normal transportation. Reactions with potassium or 2,4-hexadiyn-1,6-diol are known to form shock-sensitive explosives; those with iron salts can cause occasionally explosive thermal decomposition; and the product is otherwise incompatible with a wide variety of other substances. The toxicity of phosgene is extremely high by all routes of exposure. Vapors in air can be hazardous to life over considerable downwind distances and have a tendency to accumulate in pits, hollows, depressions, and other low areas. Decomposition of the nonflammable substance at high temperatures is said to produce chlorine, chlorides, carbon monoxide, carbon dioxide, carbon tetrachloride and possibly other toxic constituents, all of which may be less toxic than phosgene itself. The anhydrous product is not corrosive to ordinary metals, but exposure to moisture will cause corrosive conditions to develop rapidly.

Downwind evacuation should be considered immediately if phosgene is leaking from a container. Note that phosgene tanks in transportation are not equipped with pressure-relief devices and may rupture violently in fires due to overpressurization, thus releasing large quantities of toxic gases and vapors virtually instantaneously to the atmosphere.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very slightly soluble; reacts slowly

Solubility in Other Chemicals: Soluble in benzene, toluene, chloroform, glacial acetic acid, and most liquid hydrocarbons.

Specific Gravity (Liquid): 1.38 at 68°F (20°C)

Boiling Point: 45.7-46.8°F (7.6-8.2°C) at 1 atm

Melting Point: – 198.0 to – 194.8°F (– 127.8 to – 126°C)

Freezing Point: See melting point

Molecular Weight: 98.92

Heat of Combustion: Not flammable

Vapor Pressure: 1.55-1.60 atm (22.77-23.50 psia) at 68°F (20°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Phosgene used in anhydrous equipment with anhydrous reagents is not corrosive to ordinary metals. In the presence of moisture, hydrochloric acid is formed and corrosive conditions will develop rapidly, in which case monel, tantalum or glass-lined equipment should be used. Liquid phosgene may attack some forms of plastics, rubber, and coatings.

Reactivity with Water: Phosgene decomposes in water, but not vigorously, to form carbon dioxide and hydrochloric acid or hydrogen chloride.

Reactivity with Other Chemicals: Reacts with 2,4-hexadiyn-1,6-diol, powdered aluminum, alcohols, potassium, sodium, amines, t-butyl azidoformate, isopropyl alcohol, hexafluoroisopropylidene, amino lithium, lithium, iron salts, and possibly other substances.

IDENTIFICATION

Shipping Names: Phosgene (USDOT and IMO)

Synonyms and Tradenames: Carbonyl chloride; carbon oxychloride; chloroformyl chloride; carbonic acid dichloride; carbonic dichloride; diphosgene

Chemical Formula: $COC1_2$

Constituent Components (% each): 99-100% pure

UN/NA Designation: UN1076

IMO Designation: 2.3, poison gas

Physical State As Shipped: Liquefied compressed gas

Physical State As Released: Liquid, boiling liquid, or gas

Color of the Shipped Material: Colorless to light yellow

Odor Characteristics: Sharp, pungent odor in higher concentrations; like freshly mown grass or musty hay in low concentrations — mildly sweet. The sense of smell may be dulled quickly by phosgene.

Common Uses: Mfg. many organic chemicals such as urea, polycarbonates, urethane foam, dyestuffs, and isocyanates, acid chlorides, insecticides, herbacides, and pharmaceuticals. Also used in metallurgy; once used as war gas.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PHOSGENE

Division 2.3 (Poison Gas)

Square background
applicable to rail cards.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.125 to 1.0 ppm; the sense of smell for phosgene may dull quickly.

Unusual Hazards: Extremely toxic and volatile material with heavier than air vapors that may persist in pits, hollows, depressions and other low areas. Can be hazardous to life over considerable downwind distances.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.1 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard to the public is from the large quantities of highly toxic gases and vapors that may be released in an accident and pose an extreme danger over considerable downwind distances. These gases and vapors are heavier-than-air and may persist in low areas.

Hazards of Skin or Eye Contact: Contact of the skin with liquid phosgene may cause severe irritation or severe burns; prolonged exposure to phosgene gas may cause skin irritation. Contact of the eyes with the liquid may cause severe irritation and corneal injury that may result in permanent impairment of vision or blindness. In laboratory experiments, high gas concentrations also caused corneal opacification in animals.

Hazards of Inhalation: Exposure to 3-4 ppm phosgene in air usually causes throat and eye irritation and coughing, but the properties of the material are inadequate to warn of dangerous exposures. Higher levels in air eventually cause dryness of the throat, coughing, choking, tightness across the chest, pain on breathing, headache, nausea, dizziness, chills, discomfort, thirst, thick and later thin and foamy sputum, grey-blue cyanosis, pulmonary edema, pneumonia, and death from respiratory or cardiac failure. A key problem is that the period between inhalation of harmful concentrations and onset of severe effects may be several hours or more almost free of symptoms. Any exposed person must therefore be treated as if the exposure is life threatening, kept under observation up to 72 hours, and given appropriate medical care. Levels of 50-90 ppm in air can be fatal in 30 minutes or less; 25 ppm can be dangerous to life after 30 minutes; 20 ppm causes severe lung injury in 1 to 2 minutes; 12.5 ppm is dangerous to life in 30 to 60 minutes.

Hazards of Ingestion: Due to the low boiling point of phosgene, the effects of ingestion are not discussed in the available literature. At the very least, severe burns of the mouth, throat, and stomach may be expected.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. Large quantities of highly toxic non-flammable gases may be released suddenly to the atmosphere.

Hazardous Combustion Products: Heating above 482°F (250°C) forms chlorides, chlorine, carbon monoxide, carbon dioxide, carbon tetrachloride, and possibly other substances, which although toxic, are less so than phosgene.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Phosgene containers do not have pressure-relief valves. Containers may rupture violently in fire due to overpressurization.

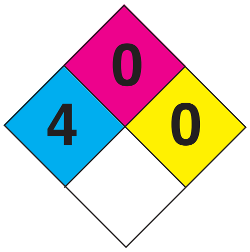
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 0.1 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1076

PHOSGENE
Division 2.3 (Poison Gas)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposures.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, including dry chemical, carbon dioxide, foam, water spray or fog.

Extinguishing Techniques: Unusual toxic vapor hazard. Material reacts relatively slowly with water to form corrosive but less hazardous product. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and safe distance to keep fire exposed containers. Be alert to the possibility that containers may rupture violently in a fire; they do not have pressure relief devices of any kind. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product and the acid formed in contact with water. Take the high volatility, extreme toxicity, and heavier-than-air nature of phosgene into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent public exposure and to allow vapors or fumes to dissipate. Phosgene spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to phosgene vapors or fumes may accelerate their dispersal in the atmosphere. Do not apply water directly to the leak area since the resulting increased corrosivity of phosgene may cause a larger leak. Do not apply water warmer than 4°F to liquid phosgene pools since this may cause an increase in vapor evolution.

CONSEQUENCE

Water runoff may contain a small amount (if any) of phosgene or hydrochloric acid from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

PHOSGENE
Division 2.3 (Poison Gas)

TECHNIQUE

WATER APPLICATION . . . Application of cold water via water spray to the surface of contained liquid pools of phosgene has some possibility of reducing emissions of phosgene vapors. Phosgene is only slightly soluble in water, somewhat heavier, and reacts slowly to form carbon dioxide and hydrochloric acid. Note, however, that this response technique has not been tested.

CONSEQUENCE

Addition of water will increase the volume of spilled product. The response may not be effective.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments. Abandon the response if it is not effective or appears to increase phosgene evolution.

TECHNIQUE

FOAM . . . There is a possibility that firefighting foam applied to the surface of liquid pools may slow the release of phosgene vapors into the atmosphere. Since foam is recommended by several sources for fighting surrounding fires, a foam blanket may have value in controlling evolution of phosgene vapors.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Cease foam application if the response is not effective or appears to increase phosgene vapor evolution.

TECHNIQUE

NEUTRALIZATION . . . There is a possibility that application of an appropriate neutralization agent to liquid phosgene may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The US DOT suggests that small spills of phosgene can be handled by flushing the area with flooding amounts of water.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid phosgene may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained phosgene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

PHOSGENE
Division 2.3 (Poison Gas)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment that is compatible with spilled product and of suitable pressure capacity.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

TECHNIQUE

DILUTION . . . The USDOT suggests that small spills of phosgene can be handled by flushing the area with flooding amounts of water.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

PHOSGENE
Division 2.3 (Poison Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake. Liquid phosgene will sink in water while simultaneously reacting and possibly boiling if the water is warmer than the boiling point of phosgene. Under certain circumstances, when the water is cold and or the phosgene is released underwater, pools of liquid phosgene may collect on the bottom and slowly react to form hydrochloric acid and carbon dioxide. It may be safest in many cases to allow the phosgene to react completely with the water and not make any attempt to recover product.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination. (Note: The water is likely to contain hydrochloric acid and slowly disappearing traces of phosgene.)

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

PHOSPHINE
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Phosphine is shipped as a liquefied compressed gas with a boiling point in the range of -126 to -121°F and an odor resembling decaying fish, garlic, and/or onion and mustard. Used in making insecticides, plastics, and electronic semi-conductors, the substance is very slightly soluble in water and lighter, so may be expected to boil or rapidly evaporate from the surface of a water body with little dissolution. It is spontaneously combustible in air under a wide variety of conditions. Nevertheless, if not immediately ignited, phosphine gas, being heavier than air, may travel a considerable distance to a source of ignition and flash back, or accumulate in pits, hollows, and depressions. Accumulations of the gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 6.2 pounds per gallon near its boiling point temperature.

Phosphine is considered stable in normal transportation when properly contained. It is said to react with water in a non-violent fashion according to one authority, while another states that it eventually self-degrades to relatively harmless phosphorus acid and water, and a third indicates that it readily oxidizes in air to toxic oxides of phosphorus. Reactions with a variety of other chemicals can result in fires or explosions. Phosphine gas is highly toxic via inhalation and contact with the liquid or concentrated cold gas may cause frostbite and possibly burns. Products of combustion may include toxic constituents, but at least one authority considers these of potentially lower toxicity than pure phosphine.

Downwind evacuation should be considered if phosphine is leaking (not on fire) until properly equipped responders have evaluated the hazard. If a fire becomes uncontrollable or a bulk container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.04 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol ether, and cuprious chloride.

Specific Gravity (Liquid): 0.746 at –130°F (– 90°C)

Boiling Point: –126 to –121°F (– 87.8 to – 85°C) at 1 atm.

Melting Point: See freezing point.

Freezing Point: – 208.8 to – 206.5°F (–133.8 to –132.5°C)

Molecular Weight: 34.0

Heat of Combustion: Unavailable (burns very hot)

Vapor Pressure: 41.3 atm (606.7 psia) at 70°F (21.1°C)

Flash Point: Spontaneously combustible; see below.

Autoignition Temperature: 212°F (100°C) reported, but see below.

Burning Rate: Unavailable

Stability: Stable in transportation but commercial phosphine containing other hydrides of phosphorus as impurities is spontaneously combustible in air, though extremely pure gas will not ignite below 300°F (150°C).

Corrosiveness: Pure phosphine appears noncorrosive to most metals but aluminum, light alloys, and copper are not recommended for use.

Reactivity with Water: Unspecified non-violent reaction may occur.

Reactivity with Other Chemicals: Reacts with oxygen, nitrous acid, nitric acid, chromium oxychloride, silver nitrate, boron trichloride, mercuric nitrate, nitrogen trichloride, oxidizing agents, chlorine oxides, dinitrogen trioxide, halogens such as chlorine or bromine, nitric oxide, and halogenated hydrocarbons. Many of these reactions produce fires or explosions. Reactions with acids produce phosphonium salts. The product readily oxidizes in air to oxides of phosphorus.

IDENTIFICATION

Shipping Names: Phosphine (USDOT and IMO)

Synonyms and Tradenames: Phosphorus trihydride; phosphorous (III) hydride, hydrogen phosphide; phosphorated hydrogen; Celphos; Delicia; Detia; Gas-Ex-B.

Chemical Formula: PH_3

Constituent Components (% each): Relatively pure

UN/NA Designation: UN2199

IMO Designation: 2.3, poison gas

Physical State As Shipped: Liquefied gas

Physical State As Released: Boiling liquid or gas

Color of the Shipped Material: Colorless gas

Odor Characteristics: Like decaying fish or garlic; unpleasant; like onions and mustard.

Common Uses: Insecticides; preparation of phosphonium halides; doping agent for electronic semi-conductors; polymerization initiator; condensation catalyst.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PHOSPHINE
Division 2.3 (Poison Gas)

Square background
applicable to rail cards.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.02 ppm appears correct but 1.5 to 3 ppm also reported.

Unusual Hazards: Highly toxic, spontaneously combustible liquefied gas that is somewhat heavier than air and may persist in pits and depressions if not ignited. Unignited gas may travel considerable distance to a source of ignition and flash back or pose toxic hazard over considerable downwind distances.

Short Term Exposure Limits (STEL): 1 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 0.3 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentration of phosphine gas that may be present in air in the spill area and over considerable downwind distances. All other exposures should also be strictly avoided.

Hazards of Skin or Eye Contact: High concentrations of phosphine gas in air may be irritating to the eyes and skin. Contact with the liquid may cause burns of the skin or eyes and frostbite according to one authority.

Hazards of Inhalation: Inhalation of phosphine may cause faintness, weakness, apathy, nausea, coughing with green sputum, vomiting, shortness of breath, stomach pain, diarrhea, back pain, a feeling of coldness, intense thirst, oppressed feeling in the chest, stupor, convulsions, pulmonary edema, paralysis, coma, cardiac arrest, and possibly death. Concentrations of 1000 - 2000 ppm are lethal to man in a few minutes while 400 - 600 ppm levels are dangerous to life in 30 - 60 minutes. Even 7 ppm will cause serious symptoms in a few hours. Note that onset of pulmonary edema may be delayed. Severe exposures may affect the kidneys, liver, and brain.

Hazards of Ingestion: Ingestion of phosphine is considered unlikely and is not discussed in the literature.

FIRE HAZARDS

Lower Flammable Limit: 1% or 1.8%; reported values vary.

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable liquefied compressed gas. May ignite spontaneously in air. Will generate large quantities of flammable gas or vapor upon release. Gas is heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Phosphoric acid, toxic oxides of phosphorus, and water are produced during combustion of phosphine. Thermal decomposition produces phosphorus and hydrogen at high temperatures.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with very cold phosphine, cold gas streams, or cold equipment containing phosphine. This may include gloves, face shields, safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA)may be necessary to prevent contact with high vapor or fume concentrations in air caused by burning phosgene due to the acid and other fumes that may be generated.

Respiratory Protection: For unknown concentrations, firefighting, or high concentrations (above 15 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister providing protection against phosphine or a chemical cartridge respirator with a full facepiece providing protection against phosphine within the use limitations of these devices. Be advised that a 1% concentration of phosphine in air may generate temperatures as high as 300°F (149°C) when drawn through an all-service mask.

2199

PHOSPHINE
Division 2.3 (Poison Gas)

FIRST AID

Nonspecific Symptoms: Faintness, nausea, coughing, difficult breathing, vomiting, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution:Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention. (Note: Do not use hot water or rub any frozen areas.)

FIRE RESPONSE

Extinguishing Materials: Only safe way to extinguish phosphine fire is to stop flow of gas since reignition is highly likely. Water spray, carbon dioxide, dry chemical, or foam may be used on residual fires.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Take the highly volatile, highly toxic, and highly flammable nature of phosphine into account while planning the response. Ground and bond all electrical equipment to prevent sparks.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Phosphine discharges may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to phosphine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. This response is suitable for unburned phosphine as well as hazardous products of combustion. Apply water at a point downwind and do not allow it to contact pools of liquid phosphine as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain some amount of phosphine or other chemicals from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

PHOSPHINE
Division 2.3 (Poison Gas)

TECHNIQUE

FOAM . . . There is a possibility that application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of phosphine vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if the initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . .Where necessary and possible, liquid phosphine may be contained by building dikes or barriers using soil, sand or other materials. Note that any spilled liquid will boil vigorously at first and continue to vaporize rapidly.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may develop in equipment.

MITIGATION

Use equipment that is compatible and of proper pressure capacity.

WATER SPILL

TECHNIQUE

MONITOR SITUATION . . . Phosphine will boil or rapidly evaporate from the water surface with very little (if any) dissolution in most cases. Any small amounts dissolved will eventually self-degrade to relatively harmless phosphorus acid and water. The following responses may only be necessary where critical water bodies are impacted.

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

PHOSPHINE
Division 2.3 (Poison Gas)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2006

PHOSPHORIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Phosphoric acid is a colorless, odorless, nonflammable, and nonvolatile liquid (may be solid) used for making fertilizers, soaps and detergents, pharmaceuticals, animal feed, rust inhibitors, and a variety of other products and chemicals. It is fully soluble in water. Solid phosphoric acid has a melting point of about 108°F, but shipments in tank vehicles are likely to be solutions in water. Although the product is not flammable, it may react with certain metals to evolve flammable and potentially explosive hydrogen gas. The product weighs approximately 15.3 pounds per gallon as a solution.

Phosphoric acid is stable in normal transportation. It reacts mildly with water with some evolution of heat, but reactions with strong caustics can cause violent spattering and considerable heat release. It is a corrosive substance that may irritate or burn bodily tissues upon contact. Products of decomposition may be toxic and may include acid fumes. Properties given below are for 75–85% concentrated solutions in water except where indicated otherwise.

If phosphoric acid is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions for liquids and at least 75 feet (25 meters) for solids. For larger spills, increase in the downwind direction as conditions warrant. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol
Specific Gravity (Liquid): 1.892 at 77°F (25°C) (pure); 1.33 at 77°F (25°C) (50% solution)
Vapor Density: 3.4
Boiling Point: Greater than 266°F (130°C) at 1 atm. Will vary with % solution.
Melting Point: 108.2°F (42.4°C) for solid acid
Freezing Point: See melting point
Molecular Weight: 98.0
Heat of Combustion: Not flammable
Evaporation Rate: Slower than water
Vapor Pressure: 5.5 mmHg at 68°F (20°C) for 45% acid
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable (Explosive) Limits: Not flammable
Stability: Stable
Polymerization Potential: Will not occur
pH: 1.5 (0.1 N)
Corrosiveness: Very corrosive to ordinary ferrous metals and alloys, particularly when hot. May attack some plastics, rubber and coatings. May also attack porcelain and graniteware when hot.
Reactivity with Water: Mild reaction with heat evolution
Reactivity with Other Chemicals: Reacts with strong caustics and certain metals (possibly producing hydrogen gas). Can react violently with sodium tetrahydroborate. Exothermic reactions with aldehydes, amines, amides, alcohols and glycols, azo-compunds, carbamates, esters, caustics, phenols and cresols, ketones, organophosphates, epoxides, explosives, combustible materials, unsaturated halides and organic peroxides. Do not mix with bleach or ammonia.

IDENTIFICATION

Shipping Names: Phosphoric acid, solid (USDOT & IMO); Phosphoric acid, liquid (USDOT); Phosphoric acid, solution (IMO)
Synonyms and Tradenames: Ortho-phosphoric acid; White phosphoric acid; Hydrogen phosphate solution
CAS Registry No.: 7664-38-2
Chemical Formula: H_3P0_4
Constituent Components (% each): Most typically 75–85% phosphoric acid with remainder water. Some grades may contain less acid.
UN/NA Designation: UN1805 liquid; UN3453 solid
IMO Designation: 8, corrosive substances
RTECS Number: TB6300000
NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 0 (Instability)
Physical State as Shipped: Solid or liquid solution
Physical State as Released: Solid or liquid solution
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless
Reportable Quantity: See Appendix I
Common Uses: Mfg. of fertilizers, soaps and detergents, phosphate compounds, activated carbon, sugar, pharmaceuticals, gelatin, animal feed, rust inhibitors, soft drinks, wax, latex, ceramics, dental cements, water treatment chemicals, food additives and numerous other products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PHOSPHORIC ACID

Class 8 (Corrosive Material)

*UN1805 (liquid); UN3453 (solid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Reactions with metals may evolve hydrogen gas that is flammable and may explode if ignited when confined.

Short Term Exposure Limits (STEL): 3 mg/m^3 (NIOSH)

Time Weighted Average (TLV-TWA): 1 mg/m^3 (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 1000 mg/m^3

Conditions to Avoid: Contact with incompatible materials; fire or sparks where hydrogen may be present when phosphoric acid comes in contact with metals; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from direct physical contact or ingestion unless acid mist is somehow evolved into the air (mist is only likely in high concentration solutions).

Hazards of Skin or Eye Contact: Strong solutions of phosphoric acid may cause severe skin burns and may also be expected to cause significant injury to the eyes, such as redness, pain, blurred vision, eye burns and permanent eye damage.

Hazards of Inhalation: A mist of phosphoric acid in air may cause irritation of the eyes, nose and throat. Severe exposure can lead to chemical pneumonitits.

Hazards of Ingestion: Ingestion of concentrated acid may result in burns of the mouth and throat, nausea, vomiting, abdominal pains, bloody diarrhea, convulsions, difficult breathing, collapse, shock and possibly death.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Not flammable

Upper Flammable (Explosive) Limit: Not flammable

Behavior in Fire: Not flammable. Some remote chance that containers may rupture in fire.

Hazardous Combustion Products: May evolve toxic vapors or acid fumes, such as phosphorous oxides, upon decomposition.

EXPLOSION HAZARDS

Explosiveness: Contact with metals may evolve hydrogen gas that may explode if ignited while confined. Some remote chance that containers may rupture in fire.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® (CPF 1; CPF 2; SL; BR; LV; Responder®; Responder® CSM; TK; F; CPE; ThermoPro); Trellchem HPS® suits; butyl rubber (gloves, suits, boots); natural rubber (gloves); neoprene rubber (gloves, suits, boots); nitrile rubber (gloves, suits, boots); polyethylene (gloves, suits, boots); polyvinyl chloride (gloves, suits, boots); Viton® (gloves, suits); Saranex® coated suits; Ultraflex Nitrile 22R gloves; Viton® 890 gloves; Neoprene 6780 gloves; Viton® 892 gloves; Nitty Gritty 65NFW gloves; Butyl 878 gloves; Hustler PVC 725R gloves; N-DEX 8005 gloves; Ultraflex Neop. 32 gloves; Nitri Solve 727 gloves; Chloroflex 723 gloves; Neo. Chloroflex N5/N8 gloves; 4H® and Silver Shield® brand gloves. The following materials are ***not*** recommended for use: Tychem® CPF 3.

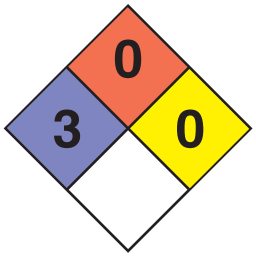
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 1000 mg/m^3): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 1000 mg/m^3), any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive pressure mode. For lesser concentrations (below 50 mg/m^3): any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece. For lesser concentrations (below 25 mg/m^3), any supplied-air respirator operated in a continuous-flow mode (may require eye protection).

1805

3453

PHOSPHORIC ACID

Class 8 (Corrosive Material)



FIRST AID

Nonspecific Symptoms: Irritation of burns of bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid using mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact do not delay, remove contaminated clothing immediately and wash skin with plenty of cold water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Give large amounts of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, alcohol-resistant foam or water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool. Do not get water inside containers.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the corrosiveness and reactivity of the product with many common metals when deciding on the appropriate response and equipment. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust. Consult a qualified specialist on neutralization techniques. Use explosion-proof and spark-proof equipment where necessary. Take into account while planning the response that phosphoric acid is highly corrosive and may evolve explosive hydrogen gas upon contact with metals. It may also have heavier than air vapors that may persist for a time in low areas.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Phosphoric acid, especially the solid, may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill by checking for pH until the spilled product is removed.

CONSEQUENCE

Hazardous levels of phosphoric acid in air may be found in the local spill area and immediately downwind, particularly if an acid mist is somehow generated in higher concentration solutions.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

PHOSPHORIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover ***solid*** phosphoric acid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to phosphoric acid vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water spray should be applied to vapors present downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain phosphoric acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL-RESISTANT FOAM . . . There is a possibility that alcohol-resistant foam applied to the surface of liquid pools may slow the release of phosphoric acid vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid phosphoric acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Phosphoric acid may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained phosphoric acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

PHOSPHORIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

PHOSPHORIC ACID
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land. Dredge or otherwise remove precipitates as necessary.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water precipitates and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

January 1989

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Phosphorus oxychloride is a colorless or slightly yellow fuming liquid that has a pungent, musty, disagreeable, and lingering odor and which solidifies at 34.2 – 35.6°F when pure. It is used for making a variety of products and other chemicals and as a doping agent for electronic semi-conductors. Although the substance is not itself flammable, various authorities strongly imply that it is an oxidizer that may ignite combustible organic matter (particularly fibrous materials like wood) upon contact. Contact with most metals in the presence of water or moisture may generate flammable and potentially explosive hydrogen gas. There is also a possibility that reactions with water may produce flashes of fire at times. The product weighs approximately 14 pounds per gallon. Phosphorus oxychloride is stable in normal transportation. It reacts violently with water or moisture to form phosphoric acid, hydrogen chloride or hydrochloric acid, and possibly spontaneously flammable phosphine gas while splattering and generating heat and fumes. The product and its vapors and fumes are highly corrosive to all bodily tissues and will also attack many common metals and some forms of plastics, rubber, and coatings. Reactions with a wide variety of other chemicals may also be vigorous or violent. There is a limited possibility that containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. Decomposition of the product in fire conditions may form toxic and irritating hydrogen chloride, oxides of phosphorus, phosgene, and possibly other toxic substances.

Downwind evacuation should be considered if a spill of phosphorus oxychloride is generating large amounts of vapors and fumes until properly equipped responders have evaluated the hazard. Note that fumes and vapors may be heavier than air.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.
Solubility in Other Chemicals: Soluble in carbon tetrachloride
Specific Gravity (Liquid): 1.68 at 68°F (20°C)
Boiling Point: 221.5 – 226.2°F (105.3 –107.9°C) at 1 atm; reported values vary.
Melting Point: 34.2–35.6°F (1.2–2°C)
Freezing Point: See melting point
Molecular Weight: 153.33
Heat of Combustion: Not flammable
Vapor Pressure: 28 – 29.3 mm Hg (0.541– 0.566 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable, but reacts with water or moisture
Corrosiveness: Corrosive to most metals except lead or nickel when dry. Corrodes steel and most metals while evolving hydrogen gas in presence of water or moisture. Stainless steel containers are acceptable for short term use, nickel or glass-lined steel for longer use. Piping may be nickel, glass, glass-lined or Teflon-lined steel with Teflon-lined plug or ball valves. Only virgin teflon or Kalrez alastomeric materials may be used, and pumps should be of nickel, Hastelloy C, or 316 stainless.
Reactivity with Water: Reacts violently with water or moisture to form phosphoric acid, hydrogen chloride or hydrochloric acid, and possibly spontaneously flammable phosphine gas while generating heat and fuming or splattering.
Reactivity with Other Chemicals: Reacts vigorously or violenty with boron triiodide, mixture of dimethyl formamide and 2,5-dimethylpyrrole, dimethyl sulfoxide, sodium, potassium, alcohols, acids, amines, alkaline materials, aluminum, alkali metals, or phenols. Also considered incompatible with carbon disulfide, 2,6-dimethylpyridine N-oxide; ferrocene-1,1,-dicarboxylic acid, and zinc. Reacts with organic matter and may possibly ignite fibrous matter such as wood.

IDENTIFICATION

Shipping Names: Phosphorus oxychloride (USDOT and ***IMO) Synonyms and Tradenames:*** Phosphorus chloride; phosphoryl chloride; phosphorus oxytrichloride; phosphorus chloride oxide; phosphorus oxide trichloride; phosphorus trichloride oxide; trichlorophosphine oxide; trichlorophophorus oxide.
Chemical Formula: $POCl_3$
Constituent Components (l each): 99% to almost 100% pure
49 STCC: 49 323 52
UN/NA Designation: UN1810
IMO Designation: 8, corrosive
Physical State As Shipped: Liquid
Physical State As Released: Solid or liquid (solidifies at 34.2–35.6°F)
Color of the Shipped Material: Colorless to pale yellow oily liquid.
Odor Characteristics: Pungent; musty; disagreeable; lingering
Common Uses: Chlorinating agent; cryoscopic solvent; making other chemicals for gasoline additives, plasticizers, pesticides, pharmaceuticals, hydraulic fluids, fire retardants, etc.; doping agent for electronic semi-conductors.

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive substance. Reacts violently with water. Contact with many metals in presence of water or moisture generates hydrogen gas.

Short Term Exposure Limits (STEL): 0.5 ppm

Time Weighted Average (TLV-TWA): 0.1 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat or fire; sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Phosphorus oxychloride is highly corrosive to bodily tissues by all routes of exposure. Major hazard is from inhalation of the high vapor and fume concentrations that may be present in air in the spill area and downwind, but ingestion and direct physical contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Phosphorus oxychloride is highly irritating and corrosive to the skin and eyes. Contact may cause tissue destruction and severe slow healing burns. Damage to the eyes may cause blindness.

Hazards of Inhalation: Vapor and fumes of phosphorus oxychloride are highly irritating and corrosive to the eyes, skin, mucous membranes, and respiratory tract. Inhalation may result in cough, burning throat, chest pain, dizziness, headache, weakness, shortness of breath, nausea, vomiting, wheezing, bronchitis, inflammation and edema of the larynx and bronchi, pulmonary edema (which may be delayed in onset), pneumonitis, and possibly death. Exposure of rats to 48 ppm in air for four hours was fatal to *50%* of the animals in laboratory experiments.

Hazards of Ingestion: Ingestion of phosphorus oxychloride may result in severe burns of the mouth, esophagus and stomach, shock, and possibly death.

FIRE HAZARDS

Lower Flammable Limit (LFL): Not flammable

Upper Flammable Limit (UFL): Not flammable

Behavior in Fire: Nonflammable liquid. There is a limited possibility that containers may rupture violently in fire due to overpressurization. May generate large quantities of corrosive fumes and vapors upon release. There is a possibility that contact with organic matter may cause ignition.

Hazardous Combustion Products: Nonflammable but decomposition in fire conditions may form irritating and toxic hydrogen chloride, oxides of phosphorus, phosphine, and possibly other hazardous substances.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Not flammable

Upper Explosive Limit (UEL): Not flammable

Explosiveness: There is a limited possibility that containers may rupture violently in fire due to overpressurization. Any hydrogen gas evolved in contact with metals may explode if ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations. Compatible materials may include neoprene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid gas canister and containing nonoxidizable sorbents providing protection against phosphorus oxychloride within the use limitations of these devices.

1810

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first-aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. Give more water if vomiting occurs naturally.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, or sand on adjacent fires. Reacts violently with water or foam but may consider rapid application of flooding quantities of water (very cautiously) if large quantities of combustibles are involved. Note that water may cause splattering, fume generation, and evolution of heat.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool. Note that addition of water may increase evolution of fumes from leaking product.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that phosphorus oxychloride may possibly ignite certain organic matter upon contact. Flammable and potentially explosive hydrogen gas may be liberated upon contact with certain metals. Use explosion-proof and spark-proof tools and equipment where necessary. Take the highly reactive and corrosive nature of the product into account when planning the response. Use insulated tanks in cold weather to prevent solidification. Keep water or moist air out of containers or equipment.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Phosphorus oxychloride spills may expose downwind areas to toxic concentrations over considerable distances in some cases if large amounts of corrosive fumes are evolved. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE .

WATER FOG OR SPRAY . . . Water fog or spray applied to phosphorus oxychloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of liquid product as this may increase fume evolution.

CONSEQUENCE

Water runoff may contain various chemicals from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

BURIAL . . . Under appropriate conditions, the spilled product may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of vapors or fumes.

CONSEQUENCE

An additional quantity of sand, earth, or similar material will become contaminated. Vapor or fume emissions may continue when the cover material is removed.

MITIGATION

Consult qualified experts. Consider adding water and neutralizing agent to surface of cover material to dilute and neutralize spilled product.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid phosphorus oxychloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid phosphorus oxychloride from a safe distance may eventually slow the release of vapors or fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may possibly be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Phosphorus oxychloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained phosphorus oxychloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Solidification of the product may clog lines or pumps. Any moisture or water in equipment may react and cause high pressures to develop.

MITIGATION

Use equipment compatible with the spilled product. Keep product warm as necessary. Use dry equipment purged of moist air.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, vermiculite, fullers earth, kitty litter, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded.. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Apply this technique only to remove final traces of spilled product.

PHOSPHORUS OXYCHLORIDE
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

PHOSPHORUS PENTASULFIDE

Division 4.3 (Dangerous When Wet)

GENERAL INFORMATION

Phosphorus pentasulfide is a light greenish yellow, greenish gray, or grayish yellow solid with an odor of rotten eggs that may paralyze the sense of smell at hazardous concentrations in air. It is used for making lube oil additives, insecticides, flotation agents, safety matches, blown asphalt, and other products and chemicals. It is heavier than water and will slowly react with water or moist air to form toxic hydrogen sulfide (H_2S) gas and corrosive phosphoric acid. It may also spontaneously heat and ignite in the presence of moisture. Phosphorus pentasulfide is a flammable solid that can be ignited by sparks or friction and its dust presents an explosion hazard in air at sufficient concentrations. Hydrogen sulfide gas evolved from reactions with water may also form explosive mixtures with air. The product weighs approximately 126.7 pounds per cubic foot.

Phosphorus pentasulfide is highly reactive and can produce heat, fire, explosions, toxic gases, and/or flammable gases in reactions with a wide variety of other chemicals and substances. The solid is noncorrosive when dry, and is shipped in aluminum or steel containers. The major public health hazard of a spill is due to the evolution of hydrogen sulfide gas that is considered highly toxic. Products of combustion may also be toxic and may include sulfur dioxide, phosphorus pentoxide, phosphoric acid, and unburned hydrogen sulfide.

Downwind evacuation should be considered on a case by case basis if the product is leaking and in contact with water or moist air. If phosphorus pentasulfide is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.

Solubility in Other Chemicals: Soluble in solutions of alkali hydroxides; slightly soluble in carbon disulfide.

Specific Gravity (Solid): 2.03 at 68°F (20°C)

Boiling Point: 955-961°F (513-516°C) at 1 atm.

Melting Point: 527-547°F (257-286°C)

Freezing Point: 527-547°F (257-286°C)

Molecular Weight: 222.27 or 444.56

Heat of Combustion: – 6050 cal/g

Vapor Pressure: Negligible for solid (not counting H_2S)

Flash Point: Flammable solid

Autoignition Temperature: 500-554°F (260-290°C)

Burning Rate: Unavailable

Stability: Unstable; can be ignited by friction or sparks. Reacts with moist air or water.

Corrosiveness: Noncorrosive when dry and shipped in aluminum or steel containers. Contact with water forms corrosive phosphoric acid.

Reactivity with Water: Reacts slowly with formation of hydrogen sulfide gas and phosphoric acid. May heat and spontaneously ignite in presence of moisture.

Reactivity with Other Chemicals: Reacts with acids, oxidizing materials, alcohols, and a very wide variety of other chemicals and substances.

IDENTIFICATION

Shipping Names: Phosphorus pentasulfide (USDOT); phosphorus pentasulphide (IMO).

Synonyms and Tradenames: Phosphoric sulfide; phosphorus persulfide; thiophosphoric anhydride; phosphorus sulfide; phosphorus pentasulphide.

Chemical Formula: P_2S_5 or P_4S_{10}

Constituent Components(% each): Various forms and mixtures; regular (low reactivity) is 99% or more pure.

UN/NA Designation: UN1340

IMO Designation: 4.1, flammable solid

Physical State as Shipped: Solid

Physical State as Released: Solid

Color of the Shipped Material: Light greenish yellow or gray; grayish yellow; light yellow.

Odor Characteristics: Rotten eggs

Common Uses: Mfg. of lube oil additives, insecticides, flotation agents, safety matches, ignition compounds, blown asphalt, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PHOSPHORUS PENTASULFIDE

Division 4.3 (Dangerous When Wet)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.13-0.77 ppm for hydrogen sulfide.

Unusual Hazards: Reaction with water or moisture produces flammable and toxic gas and corrosive acid; may lead to spontaneous ignition. Solid product is subject to ignition by friction and sparks. Dust and hydrogen sulfide gas may form explosive mixtures with air. Hydrogen sulfide numbs the sense of smell.

Short Term Exposure Limits(STEL): 3 mg/m^3 for 15 minutes. (ACGIH) (Note: 15 ppm for H_2S.)

Time Weighted Average(TLV-TWA): 1 mg/m^3 over each 8 hours of a 40 hour work week.(ACGIH) (Note: 10 ppm for H_2S.)

Conditions to Avoid: Heat, fire, sparks, and friction; contact with water, moisture, or incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of hydrogen sulfide gas. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Prolonged skin contact with phosphorus pentasulfide may cause mild to moderate irritation. Contact with the eyes may result in severe irritation and possible corneal injury that may be delayed for a matter of hours.

Hazards of Inhalation: Hydrogen sulfide gas evolved from phosphorus pentasulfide is a rapidly acting systemic poison that numbs the sense of smell after smelling of rotten eggs. Symptoms of coughing, dizziness, eye irritation, headache, fatigue, lacrimation, and respiratory system irritation are common. High levels may cause respiratory paralysis and death or severe breathing difficulties (pulmonary edema) that may be delayed in onset.

Hazards of Ingestion: Symptoms of ingestion may range from minor irritation and coughing to death due to respiratory failure depending on the amount ingested.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable solid. Easily ignited.

Hazardous Combustion Products: Sulfur dioxide, phosphorus pentoxide, phosphoric acid, and unburned hydrogen sulfide.

EXPLOSION HAZARDS

Lower Explosive Limit: 0.05 ounce/ft^3 for 200 mesh dust

Upper Explosive Limit: Unavailable

Explosiveness: Dust may form explosive mixtures with air. Explosion may result if hydrogen sulfide gas is ignited in a confined area. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section.)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air if the product is burning.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations), a self-contained breathing apparatus (SCBA) with full facepiece(or the equivalent).

1340

PHOSPHORUS PENTASULFIDE

Division 4.3 (Dangerous When Wet)

FIRST AID

Nonspecifc Symptoms: Irritation of the eyes, skin, or respiratory system; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Remove loose powder. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: Be careful not to ignite powder by causing friction.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately, induce vomiting and give more water. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry sand, carbon dioxide, dry chemical. Reacts with water or foam but may consider using water spray or fog for large fires. Note that some authorities suggest withdrawal and letting large fires burn out.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated when product is burning. Move container from fire area if no risk. Note that addition of water to nonburning product may evolve flammable gas.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Remove all sources of heat, sparks, or open flames. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water.Note that intake of high contaminated water may result in damage or rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the reactivity, toxicity, and flammability hazards of the product into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Phosphorus pentasulfide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small quantitites have spilled and the product is kept dry.

CONSEQUENCE

Hazardous levels of phosphorus pentasulfide or hydrogen sulfide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Keep spilled product as dry as possible.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow gases to dissipate. Phosphorus pentasulfide spills may expose downwind areas to toxic or flammable concentrations of hydrogen sulfide over considerable distances, particularly if large quantities have spilled in a moist or wet environment.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

PHOSPHORUS PENTASULFIDE
Division 4.3 (Dangerous When Wet)

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid phosphorus pentasulfide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly. Avoid friction that may ignite phosphorus pentasulfide.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to hydrogen sulfide gas from a point downwind of the spill may accelerate its dispersal in the atmosphere. Keep water away from phosphorus pentasulfide.

CONSEQUENCE

Water runoff may contain a small amount (if any) of chemical from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for treatment or disposal techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Phosphorus pentasulfide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Liquid phosphoric acid formed by reaction of phosphorus pentasulfide with water may percolate into soil or seep through dike material. This may result in spreading of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Keep phosphorus pentasulfide as dry as possible by covering with plastic sheet or other compatible material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases, particularly if moisture or water is present.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material. Keep product as dry as possible.

PHOSPHORUS PENTASULFIDE
Division 4.3 (Dangerous When Wet)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Friction may ignite phosphorus pentasulfide. Excessive agitation may cause phosphorus pentasulfide dust to become airborne. Spilled product poses a fire hazard.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation and friction. Eliminate ignition sources. Do not operate motorized removal equipment in potentially unsafe atmospheres. Consult qualified experts for advice and assistance where necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product or any phosphoric acid formed to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture hydrogen sulfide that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

PHOSPHORUS PENTASULFIDE
Division 4.3 (Dangerous When Wet)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

PHOSPHORUS TRICHLORIDE

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Phosphorus trichloride is a colorless or slightly yellow fuming liquid with a pungent and irritating odor resembling hydrochloric or muriatic acid. It is highly toxic by inhalation. It is used during electrodeposition of metal on rubber and for making pesticides, surfactants, gasoline additives, plasticizers, dyestuffs, textile finishing agents, germicides, medicinal products, and other chemicals. Although the substance is not itself flammable, it is a strong oxidizer that may ignite combustible organic materials upon contact. In addition, contact with many common metals except nickel and lead may generate flammable and potentially explosive hydrogen gas. It hydrolyzes with water to form hydrochloric acid and phoshoric acid and may produce flashes of fire. The product weighs approximately 13.1 pounds per gallon.

Phosphorus trichloride is fairly volatile and reacts violently with water or moisture in air to generate heat, spontaneously flammable phosphine gas, hydrogen chloride, phosphorus acids, and even free spontaneously flammable phosphorous. The product and its fumes and vapors are highly corrosive to all bodily tissues and will also attack many common metals and some forms of plastics, rubber, and coatings. Reactions with acetic acid, nitric or nitrous acid, chromyl chloride, or sodium may be explosive and the product is also reactive with a wide variety of other chemicals and substances. Excessive heat may cause rupture of containers.

Downwind evacuation should be considered if a spill of phosphorus trichloride is generating large amounts of vapors and fumes. Fumes and vapors are heavier than air.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts violently; see below.

Solubility in Other Chemicals: Soluble in benzene, carbon disulfide, carbon tetrachloride, chloroform and ether.

Specific Gravity (Liquid): 1.575 at 68ºF (20ºC)

Vapor Density: 4.75

Boiling Point: 168.8ºF (76ºC) at 1 atm.

Melting Point: See freezing point.

Freezing Point: -169.2ºF (-111.8ºC)

Molecular Weight: 137.35

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): One source reports 1.

Vapor Pressure: 100 mmHg (1.93 psia) at 69.8ºF (21ºC)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Flammable Limits: Not flammable

Stability: Stable, but reacts with water or moisture.

Polymerization Potential: Will not occur.

pH: Unavailable

Corrosiveness: Attacks most common metals except nickel and lead with formation of hydrogen. Will attack some forms of plastics, rubber, and coatings. Not corrosive to iron when dry. Shipped in lined or clad steel, nickel, or bare carbon steel with less than 0.31% carbon.

Reactivity with Water: Violent reaction producing heat, phosphine gas, hydrogen chloride, phosphorus acids, phosphorous, and flashes of fire.

Reactivity and Incompatibility: Reacts with acetic acid, nitric and nitrous acid, chromyl chloride, sodium, hydroxlamine, powdered aluminum, potassium, dimethyl sulfoxide, fluorine, iodine monochloride, lead dioxide, oxidizing acids, alkalis, organic matter, and a wide variety of other chemicals and substances.

IDENTIFICATION

Shipping Name(s): Phosphorus trichloride (USDOT & IMO)

Synonyms and Tradenames: Chloride of phosphorus; Phosphorus chloride; Phosphorus (III) chloride.

CAS Registry No.: 7719-12-2

Chemical Formula: PCl_3

Constituent Components (% each): 8.5% or more pure with some $POCl_3$.

UN/NA Designation: UN1809

IMO Designation: 6.1, Toxic substances

RTECS Number: TH3675000

NFPA 704 Hazard Rating: 4(Health): 0(Flammability): 2(Reactivity): Reacts with water

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless or light yellow.

Odor Characteristics: Pungent, sharp, irritating; like hydrochloric acid.

Reportable Quantity: See appendix I.

Common Uses: Electrodeposition of metal on rubber; iridescent metallic deposits; mfg. of pesticides, surfactants, gasoline additives, plasticizers, dyestuffs, textile finishing agents, germicides, medicinal products, and other chemicals and products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PHOSPHORUS TRICHLORIDE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic by inhalation and corrosive. Reacts violently with water. Contact with many metals generates hydrogen. Heat may cause containers to burst.

Short Term Exposure Limit (STEL): 0.5 ppm (3 mg/m^3)

Time Weighted Average (TLV-TWA): 0.2 ppm (1.5 mg/m^3)

Ceiling (C) Limit: Unavailable

IDLH: 25 ppm

Conditions to Avoid: Heat; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Phosphorus trichloride is highly corrosive to bodily tissues by all routes of exposure. Major hazard to public is inhalation of fumes or vapors in air but ingestion and direct physical contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Phosphorus trichloride is highly irritating and corrosive to the skin and eyes. Contact may cause severe irreversible injury or burns.

Hazards of Inhalation: Vapor and fumes of phosphorus trichloride are highly irritating and corrosive to the skin, eyes, mucous membranes, and lungs. Inhalation may cause injury ranging from mild bronchial spasm to pulmonary edema. Effects may be delayed up to 24 hours and may include symptoms of temporary toxic hepatitis. Exposure to only 50 ppm in air for 4 hours was fatal to 50% of guinea pigs in laboratory experiments.

Hazards of Ingestion: Ingestion may result in severe burns of the mouth, throat, and stomach.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to over pressurization. May generate large quantities of corrosive vapors and fumes upon release. Contact with organic matter may cause ignition.

Hazardous Combustion Products: Thermal decomposition may produce toxic fumes of phosphorous oxides and/or phosphine. Also see decomposition products of water reaction.

EXPLOSION HAZARDS

Explosive Potential: Very reactive. Containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures (see general information section). Explosive hydrogen gas evolved in reactions with some metals and may explode if ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Teflon® is reported to provide more than 4 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 25 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use of limitations of these devices and containing nonoxidizable sorbents providing protection against phosphorus trichloride.

1809

PHOSPHORUS TRICHLORIDE

Division 6.1 (Poisonous Materials)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. Give more water if vomiting occurs naturally.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, or sand on adjacent fires. Reacts with water or foam but may consider using large amounts of water spray or fog if large quantities of combustibles are involved.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool. Note that addition of water may increase evolution of corrosive fumes from leaking product.

SPILL RESPONSES

General Information: Phosphorus trichloride is a highly toxic and corrosive liquid that may cause environmental contamination. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that phosphorus trichloride may ignite organic matter upon contact and that hydrogen gas may be liberated upon contact with certain metals. Use intrinsically safe equipment where necessary.

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

PHOSPHORUS TRICHLORIDE
Division 6.1 (Poisonous Materials)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases. Phosphorus trichloride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to phosphorus trichloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point upwind of the spill and should not be allowed to contact pools of phosphorus trichloride.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of phosphorus trichloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

BURIAL . . . Under special emergency conditions, the spilled product may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of vapors or fumes. The material must be recovered and disposed of in a proper manner.

CONSEQUENCE

An additional quantity of sand, earth, or similar material will become contaminated. Vapor or fume emissions may continue when the cover material is removed.

MITIGATION

Consult qualified experts. Consider adding neutralizing agent to surface of cover material to dilute and neutralize spilled product. Consult a qualified expert on the appropriate neutralizing agents.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid phosphorus trichloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The use of water with phosphorus trichloride may react and create a toxic vapor cloud. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time. Flashes of fire may be observed.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

PHOSPHORUS TRICHLORIDE
Division 6.1 (Poisonous Materials)

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Phosphorus trichloride may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined phosphorus trichloride may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth, or other absorbent compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

PHOSPHORUS TRICHLORIDE
Division 6.1 (Poisonous Materials)

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

PHOSPHORUS, WHITE OR YELLOW

Division 4.2 (Spontaneously Combustible)

GENERAL INFORMATION

Yellow or white phosphorus is a soft waxy solid with a sharp pungent odor resembling garlic. It may be shipped in a container of water or as a solid or liquid in an atmosphere of inert gas. Uses include the manufacture of munitions, pyrotechnics, explosives, smoke bombs, artificial fertilizers, rat poisons, and other products and chemicals. White or yellow phosphorus is barely soluble in water and heavier, so may be expected to sink and dissolve at an extremely slow rate. Upon exposure to air, the dry product or wet product that has dried will ignite spontaneously at a temperature at or above 86°F and generate intense white smoke and a greenish light. The product weighs approximately 15.2 pounds per gallon.

White or yellow phosphorus does not react with water and is stable as long as it is kept wet or otherwise excluded from air. Contact of the product with oxidizing materials (including elemental sulfur) may cause a vigorous reaction or explosion. Contact with strong caustics may result in evolution of poisonous and flammable phosphine gas, and the product is otherwise reactive with a wide variety of substances. Smoke of the burning product is irritating and toxic by inhalation, and the product is highly hazardous if physically contacted or ingested.

If phosphorus, white or yellow, is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, 0.0003 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alkali, ammonia, benzene, carbon disulfide, chloroform, ether, and toluene.

Specific Gravity (Solid): 1.82 at 68°F (20°C)

Boiling Point: 535.5°F (279.7°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: 111.4°F (44.1°C)

Molecular Weight: 123.89

Heat of Combustion: – 5900 cal/g

Vapor Pressure: 0.026 mm Hg (0.0005 psia) at 68°F (20°C)

Flash Point: Ignites spontaneously in air

Autoignition Temperature: 86°F (30°C)

Burning Rate: Unavailable

Stability: Stable when excluded from air

Corrosiveness: Not corrosive in absence of air or water.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with oxidizing materials, strong caustics, air, sulfur, beryllium, thorium, zirconium, various halogens, oxides, fluorides, azides, iodates, nitrides, acids, iodides, chlorides, carbides, chlorates, bromates, acid anhydrides, iodides, and other chemicals.

IDENTIFICATION

Shipping Names: Phosphorus, white or yellow, under water or solution (USDOT & IMO); phosphorus, white or yellow, dry (USDOT & IMO);phosphorus (IMO); phosphorus white, molten (USDOT & IMO).

Synonyms and Tradenames: Phosphorus; WP; white phosphorus; yellow phosphorus; elemental phosphorus.

Chemical Formula: P_4

Constituent Components(% each): 99.8-99.9% pure

UN/NA Designation: UN1381 (USDOT, IMO); UN2447 (molten liquid), (IMO)

IMO Designation: 4.2, spontaneously combustible

Physical State as Shipped: Liquid or waxy solid

Physical State as Released: Solid, or liquid that solidifies

Color of the Shipped Material: White to yellow

Odor Characteristics: Sharp, pungent, like garlic

Common Uses: Mfg. of munitions, pyrotechnics, explosives, smoke bombs, other incendiaries, artificial fertilizers, rat poisons, phosphor bronze alloy, semiconductors, electroluminescent coating, and various chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PHOSPHORUS, WHITE OR YELLOW

Division 4.2 (Spontaneously Combustible)

See "UN/NA Designation"
for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: May ignite spontaneously upon contact with air. Smoke is highly toxic.

Short Term Exposure Limits(STEL): 0.3 mg/m^3 for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 0.1 mg/m^3 over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Drying of product; entry to sewers or water bodies; contact with incompatible materials; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: All exposures to white or yellow phosphorus and its fumes or smoke should be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with solid white or yellow phosphorus may cause deep thermal burns and blisters. Fumes may cause severe eye irritation involving blepharospasm, sensitivity to light, and lacrimation. Contact of the eyes with the solid product may result in severe injury.

Hazards of Inhalation: Smoke and fumes are irritating to the eyes and respiratory tract. High concentrations in air may cause severe breathing difficulties that may be delayed in onset. Asphyxiation may occur if oxygen is depleted in confined areas due to phosphorus burning.

Hazards of Ingestion: Ingestion may cause nausea, vomiting, low blood pressure, jaundice, depression, delirium, abdominal pain, and possibly coma after a delay of a few hours with breath and vomit smelling of garlic. Victim may get well in 24-36 hours and then become ill again. Death may occur in severe exposures.

FIRE HAZARDS

Lower Flammable Limit: Flammable solid

Upper Flammable Limit:: Flammable solid

Behavior in Fire: May ignite spontaneously in air.

Hazardous Combustion Products: Highly irritating and toxic, may include phosphoric acid fumes and phosphorus pentoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Flammable solid

Upper Explosive Limit:: Flammable solid

Explosiveness: Contact with other chemicals such as oxidizing materials may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Use fire resistant clothing where possible.

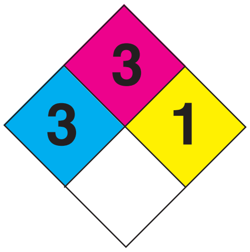
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency particulate filter respirator with a full facepiece within the use limitations of these devices.

1381

See "UN/NA Designation"
for other ID numbers.

PHOSPHORUS, WHITE OR YELLOW

Division 4.2
(Spontaneously Combustible)



FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues; other symptoms of ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. (Note: The skin should be kept wet until medical attention is obtained to prevent any remaining phosphorus from burning.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Flood with water but do not scatter material. Cover with wet sand or wet dirt.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of phosphorus may be dangerous. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that all physical contact with white or yellow phosphorus should be avoided and that the product may ignite spontaneously in air when dry. Water in containers should be maintained between pH 5.5 and 6.5 if possible to prevent evolution of hydrogen from action of any phosphoric acid present on metal and the evolution of toxic and flammable phosphine gas.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . White or yellow phosphorus may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the product has not ignited and is kept wet or buried under wet sand or dirt.

CONSEQUENCE

Hazardous levels of white or yellow phosphorus in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

PHOSPHORUS,
WHITE OR YELLOW
Division 4.2 (Spontaneously Combustible)

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. White or yellow phosphorus spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts are burning and the smoke may affect populated areas.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECNNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to white or yellow phosphorus smoke or fumes may absorb vapors, knockdown smoke or fumes or accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of chemicals from contact with smoke or fumes in the atmosphere.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . White or yellow phosphorus may be contained by building dikes or barrier using earth, sand or similar materials, and then covered with water, wet sand or dirt.

CONSEQUENCE

Any phosphorus that escapes may ignite upon drying.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Keep product wet before and after removal.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product. The phosphorus may be covered with water or wet sand or dirt.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines. Work should be conducted carefully and the spilled product should be kept wet at all times.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination or fires.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Keep product under water.

PHOSPHORUS,
WHITE OR YELLOW
Division 4.2 (Spontaneously Combustible)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may ignite if permitted to dry.

MITIGATION

Consult qualified experts for guidance. Keep spilled product wet.

October 1993

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Phthalic anhydride is shipped in the form of colorless, white, or pale yellow solid flakes, crystals or powders, or as a hot molten liquid with an odor that is variably described as mild or choking and acrid. The substance is heavier than water and slightly soluble, so most may be expected to sink to the bottom of a water body and dissolve at a fairly slow but appreciable rate. Once dissolved, phthalic anhydride slowly combines with water to form phthalic acid which corrodes ordinary iron and mild steel while generating flammable and potentially explosive hydrogen gas. Clouds of phthalic anhydride dust dispersed in air may easily be ignited and either burn or explode. Spills of molten liquid may evolve flammable vapors immediately upon release or after a relatively small degree of preheating. Such vapors may travel some distance to a source of ignition and flash back; accumulations in confined spaces such as building or sewers may explode if ignited. Contact of the burning liquid with water or firefighting foam may result in violent frothing, spattering, steam generation, and other possible hazards. Solid forms weigh about 95.5 pounds per cubic foot while the hot molten liquid weighs about 10 pounds per gallon.

It is stable in normal transportation and reported as capable of attacking some forms of plastics, rubber and coatings. Reactions with copper (II) oxide, sodium nitrite, or fuming nitric acid and sulfuric acid may explode or form explosive materials upon heating. It is reported as being reactive with strong oxidizing agents, alkalis, or mineral acids and may be reactive with a broad range of other chemical substances. Toxic vapors evolved from the hot molten liquid and thermal burns from contact with hot liquid are of most concern. Products of combustion are not well-defined but are likely to include corrosive phthalic acid fumes, carbon monoxide, carbon dioxide, and other harmful substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if phthalic anhydride (and particularly the hot molten liquid) is leaking from its container.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble; 0.62 g/100 g water and 0.6% by wgt at 68°F (20°C).

Solubility in Other Chemicals: Soluble in alcohol and carbon disulfide.

Specific Gravity: Approx 1.53 at 68°F (20°C) as solid; 1.2 at 275°F (135°C) as molten liquid.

Boiling Point: 543 - 545°F (284 - 285°C) at 1 atm.

Melting Point: 267.4 - 268.9°F (130.8 - 131.6°C).

Freezing Point: See melting point.

Molecular Weight: 148.12.

Heat of Combustion: - 5,263 cal/g.

Vapor Pressure: Values range from 0.0002 - 0.03 mm Hg at 68°F (20°C).

Flash Point: 304 - 305°F (151.1 - 151.7°C), closed-cup; 329°F (165°C), open-cup.

Autoignition Temperature: 1,058 to 1,083°F (570 to 583.9°C).

Burning Rate: Not available. Stability: Stable.

Corrosiveness: Compatible with most materials when dry but forms phthalic acid in presence of moisture or water and this corrodes ordinary iron and mild steel while generating flammable and potentially explosive hydrogen gas. Phthalic anhydride may attack some forms of plastics, rubber and coatings.

Reactivity with Water: Combines slowly with water to form corrosive phthalic acid while generating some amount of heat.

Reactivity with Other Chemicals: Mixture with copper (II) oxide or sodium nitrite may explode violently upon heating. Addition of fuming nitric acid to phthalic anhydride dissolved in sulfuric acid at an elevated temperature is reported to have caused an eruptive decomposition to occur after a 2 hour delay and may result in formation of potentially explosive substances. Otherwise reported as incompatible with strong oxidizing materials (which may cause a fire or explosion), alkalis (strong bases or caustics), mineral acids, and a broad range of other materials.

IDENTIFICATION

Shipping Names: Phthalic anhydride.

Synonyms and Tradenames: 1,3-Dihydro-1,3-dioxoisobenzofuran; 1,2-benzenedicarboxylic acid anhydride; benzene-o-dicarboxylic acid anhydride; 1,2-benzenedicarboxylic anhydride; 1,3-dioxophthalan; 1,3-isobenzofurandione; PAN; phthalandione; 1,3-phthalandione; phthalanhydride; phthalic acid anhydride.

Chemical Formula: $C_6H_4(CO)_20$.

Constituent Components (% each): Typically 99% or more pure.

UN/NA Designation: UN2214.

IMO Designation: 8, corrosive material.

Physical State As Shipped: Solid flakes, crystals or powder, or molten liquid.

Physical State As Released: Same as shipped.

Color of the Shipped Material: Usually colorless crystals, white flakes or powder, or colorless molten liquid. May be pale yellow at times.

Odor Characteristics: Variably described as mild or choking and acrid.

Common Uses: Making plasticizers, resins, dyes, pharmaceuticals, polyesters, insecticides, pigments, and various other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.050 to 0.115 ppm (0.32 to 0.72 mg/m^3)
Unusual Hazards: Phthalic anhydride may remain molten under a solid crust; check carefully before walking on such crusts. Use of water or foam on fires must be undertaken carefully to avoid frothing, spattering, and potential tank boilover hazards. Entry of water or other volatile liquids into closed tanks of the molten liquid may result in rapid steam or vapor generation and potential container rupture. Pressure relief valves on tanks of hot molten liquids may be susceptible to plugging with solid and subsequent malfunction. Flammable and potentially explosive hydrogen gas may be generated if phthalic acid contacts and corrodes iron or mild steel. Concentrated hot vapors of phthalic anhydride, upon cooling, may cover a wide area with a fluffy deposit of the solid material. The substance has several unusual toxicological characteristics.
Short Term Exposure Limit (STEL): Not established
Time Weighted Average (TWA) Limit: 1 ppm (6 mg/m^3) over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989).
Ceiling (C) Limit: Not established
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; actions that create phthalic anhydride to become an airborne dust. See "Unusual Hazards" for additional information.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the vapor, dust, and/or fume concentrations that may be present in air in the spill area and over some downwind distances, particularly and especially if molten phthalic anhydride has been discharged at a high temperature. Direct contact and ingestion should also be avoided.
Hazards of Skin or Eye Contact: Available data on this topic are not entirely consistent. The dust, vapor, or fumes of phthalic anhydride are reported to cause persistent eye irritation, stinging, lacrimation, inflammation, and possibly severe burns and permanent damage to the cornea if not immediately removed. The effects of skin contact with phthalic anhydride at normal temperatures is aggravated by moisture. As best as can be determined, contact with dry skin may not result in any pain or sensation of irritation for a time but may lead to delayed reddening of the skin, blistering, peeling, and possibly itching, swelling, brown staining of the skin, and/or a rash; superficial burns may progress to severe and deep burns as the time of contact increases. When the skin is moist or wet, irritation is felt more quickly and the above effects may occur more rapidly. Confinement of the chemical under clothes or in shoes may additionally aggravate its effects. The skin of some susceptible people may become sensitized upon repeated exposure such that they become allergic. Contact of molten phthalic anhydride with eyes or skin can result in severe thermal burns and possibly permanent injury. It may adhere to skin, hair and clothes, causing burns of severity depending on amount and extent of contact. Do not wear contact lenses when working with this chemical.
Hazards of Inhalation: The dust, vapor, or fumes of phthalic anhydride are reported to cause eye irritation and signs of nose, throat, and mouth irritation at concentrations of 4 to 5 ppm (25 to 30 mg/m^3) in air. Symptoms of exposure at higher levels are variably reported to include irritation and ulcers of the respiratory tract, coughing, sneezing, drowsiness, vomiting, excessive discharge and bleeding from the nose, atrophy of the nasal mucosa, sore throat, hoarseness, inflammation of the larynx and lungs, bloody sputum on occasion, difficulty in breathing, bronchitis, possible liver or kidney injury, cyanosis, and/or death in extreme cases. Exposures may cause asthma attacks in those who have previously had asthma. Repeated exposures may cause bronchitis and asthma and/or may result in sensitization of the respiratory system in some people such that they become allergic to the chemical and may experience bronchial asthma attacks if exposed again to even small amounts. Exposures may also aggravate the conditions of people with preexisting bronchitis or emphysema. The NIOSH IDLH (1990) for the substance is 10,000 mg/m^3, which is approximately equivalent to 1,625 ppm. Note that the saturated vapor concentration of phthalic anhydride is somewhere in the range of 0.26 - 39.5 ppm at 68°F (20°C); 1,315 ppm at 205.7°F (96.5°C); 7,895 ppm at about 267.8°F (131°C); and roughly 14,080 ppm at 280°F (137.8°C). At 68°F, 1 ppm is approximately equal to 6.16 mg/m^3 in air.
Hazards of Ingestion: Phthalic anhydride is of low to moderate toxicity by ingestion. Reported symptoms include severe irritation and possibly burns of the mouth and throat, irritation of the gastrointestinal tract, stomach cramps, nausea, vomiting, general weakness, dizziness, drowsiness, diarrhea, possible liver and kidney injury, shock, convulsions, coma, and death in extreme cases. Laboratory experiments have shown that single oral doses required to kill 50% of rats are in the range of 1.1 to 4.0 grams of phthalic anhydride per kilogram of an animal's body weight.

FIRE HAZARDS

Lower Flammable Limit: 1.7% by volume as vapor in air.
Upper Flammable Limit: 10.4 - 10.5% by volume as vapor in air.
Behavior in Fire: Solid phthalic anhydride requires considerable heating for ignition but powders and dusts, if dispersed in air, may possibly be easily ignited and burn or explode. Molten liquid may be at or above its flash point or require some heating upon release to be easily ignited or to produce flammable vapors which may travel to a source of ignition and flash back.
Hazardous Combustion Products: Not well-defined; likely to include phthalic acid fumes, carbon monoxide, carbon dioxide, and other harmful substances.

EXPLOSION HAZARDS

Explosiveness: A cloud of phthalic anhydride dust or powder dispersed in air and at or above its lower explosive limit concentration may burn or explode if ignited. An explosion may result if vapors evolved from molten phthalic anhydride at or

2214

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS *(CONTINUED)*

above its flash point are ignited in a confined area. Contact with certain other chemicals may result in an explosion. Only one of many sources of information reviewed indicated containers may explode or rupture violently in a fire; the risk is therefore deemed to be limited but not negligible. Potentially explosive hydrogen gas may be generated while phthalic acid corrodes certain metals. Entry of water or another volatile liquid into a closed tank of the molten liquid may possibly result in rapid steam or vapor generation and potential container rupture due to overpressurization.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with solid forms of phthalic anhydride at normal temperatures. This may include rubber boots, gloves, face shields, vapor-tight or dust-proof safety goggles, and other clothing including aprons or coveralls. Equipment should prevent any possibility of skin or eye contact with molten phthalic anhydride; this may include but not be limited to hard hats, face shields, vapor-tight safety goggles, and heat-resistant gloves, boots without open tops, and other appropriate clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor concentrations in emergencies involving spills of molten phthalic anhydride or contact with products of combustion in air during fires. Note that the temperature of molten phthalic anhydride may be sufficiently high that many synthetic plastic or rubber materials may melt or lose their strength upon contact. According to manufacturers of the chemical, neoprene is chemically compatible with phthalic anhydride. Be advised that many factors affect the suitability of a material for any given application. Ensure that the specific protective clothing and devices chosen will provide adequate protection under actual conditions to be encountered.

Respiratory Protection: For unknown concentrations, general use, fire fighting, or emergencies involving molten phthalic anhydride, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). Consult experts for advice on the types of respirators that may provide adequate protection against various levels of dust and/or vapors in air during normal or other non-emergency type operations.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, drowsiness, dizziness, nasal discharge or bleeding, sore throat, difficulty in breathing, nausea, vomiting, stomach cramps, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Relief of nose or throat irritation may be achieved by spraying or gargling with water if victim is conscious.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get immediate medical attention if eye contact has occurred or skin irritation persists or develops after washing; contact with molten phthalic anhydride may require immediate treatment for thermal burns. If liquid has solidified over burns, remove as much as possible manually and soak off remainder in cold water before burn treatment. Be advised that removal of solidified molten material from the skin or the area of the eyes may require professional medical assistance. Contaminated leather clothing should be discarded.

First Aid for Ingestion: Get medical attention immediately or advice on whether water should be administered and/or whether vomiting should be induced if the victim is conscious. If vomiting occurs naturally or is induced, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Steam is an effective extinguishing agent for molten product fires in tanks. Otherwise, use dry chemical, carbon dioxide, water spray or foam. Authorities disagree as to whether regular or alcohol foam should be used; it is possible that both may be effective to some degree. Note that application of water or foam as a direct stream onto burning phthalic anhydride may result in potentially violent frothing or spattering; entry into burning tanks of the product may possibly result in violent frothing or boilover that may hazardous to nearby personnel. Apply water or foam as a spray with caution and from a distance at first.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes or smoke is anticipated. Move container from fire area if no risk. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after the fire is out but do not direct water streams into burning containers. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, use professional judgment to decide whether to withdraw and let fire burn based on the intensity of the fire, the high boiling point and low vapor pressure of phthalic anhydride, and whether or not it was initially a hot molten liquid in its container. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire. Based on the properties and specified hazards of other molten liquids, it is probably not prudent to depend on tank safety pressure relief devices to limit pressures in tanks; these may possibly become plugged with solid material.

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product or phthalic acid. Ground all equipment and transfer lines as necessary prior to use. Obtain expert advice with respect to cargo transfer procedures in the case of molten product. Note there is some small possibility that discharge of a carbon dioxide fire extinguisher at the point of leakage of molten phthalic anhydride has the potential to solidify and stop the leak, at least temporarily. Other means of attempting to solidify the leaking product via cooling and then plugging the hole may also work. Whether or not a "plug" or solid phthalic anhydride by itself will hold depends on several factors including the amount of liquid remaining in the container and its temperature. It may become necessary to repeat the procedure several times until the leak can be patched or to ultimately abandon the effort. Use professional judgment in attempting this type of response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Solid phthalic anhydride or smaller quantities of the rapidly cooling molten product will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in these cases to simply monitor the situation until the product is removed.

CONSEQUENCE

Hazardous levels of phthalic anhydride vapor or dust may be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind. Avoid activities that generate airborne dust.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Large discharges of molten phthalic anhydride may expose downwind areas to toxic concentrations (and possibly flammable concentrations if the liquid is well above its flash point temperature) over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid phthalic anhydride with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly. Consider first covering the spilled product with dry sand or earth.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to phthalic anhydride dust, vapors, or fumes may knock them down and/or accelerate their dispersal in the atmosphere. Application of water fog to the surface of molten liquid may help control its spreading, absorb heat, and help form a solid crust over the material that may assist in reducing vapor emissions. Maintenance of a layer of water on top of a contained pool of molten liquid that has solidified on its surface may further reduce vapor emissions. Wetting down of exposed phthalic anhydride powder may reduce generation of airborne dust. Note previous warnings about frothing and other hazards of applying water to very hot molten liquids. Be advised that firefighting foams may have similar benefits and effects if applied to the surface of molten phthalic anhydride pools.

CONSEQUENCE

Some phthalic anhydride will dissolve in any water applied or used to generate foam and then combine with the water to form corrosive phthalic acid.

MITIGATION

Contain contaminated runoff and neutralize and/or remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Use caution when at first applying water or foam to the molten liquid.

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Solid or molten phthalic anhydride or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting (capable of withstanding the temperature of molten liquid where necessary) covered with rocks and dry soil or sand, or via other appropriate methods. It may be prudent to permit molten phthalic anhydride to solidify before attempting cleanup. Consider use of a fine water fog or spray to accelerate solidification and cooling of molten liquid pools, keeping in mind the potential frothing problem and the fact that any water used will dissolve some of the phthalic anhydride and form corrosive phthalic acid.

CONSEQUENCE

Contained liquids, particularly contaminated water runoff, may percolate into soil or seep through dike material. This may result in spread of contamination.

MITIGATION

Remove contained product or neutralize and/or remove contaminated runoff to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product, particularly liquid phthalic anhydride and any contaminated water runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained product or neutralize and/or remove contaminated runoff as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated pools of contaminated water runoff may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. This response is unlikely to be appropriate for molten phthalic anhydride since cooling of the product may result in its solidification and subsequent plugging or clogging of transfer or storage equipment (unless it is specially designed for this purpose).

CONSEQUENCE

Incompatible equipment may become damaged or develop leaks. Note that any phthalic acid formed is not only corrosive but may generate flammable and potentially explosive hydrogen gas in contact with certain metals.

MITIGATION

Use equipment compatible with the spilled product. Take appropriate precautions against fires or explosions caused by generation of hydrogen.

TECHNIQUE

ABSORPTION . . . Spreading of contaminated water runoff may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil, solid or solidified phthalic anhydride, and/or various chemical residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors or gases present in the area (such as vapors from very hot molten phthalic anhydride or any hydrogen gas that may evolve when metals are corroded by phthalic acid) may be ignited by motorized removal equipment. Similarly, the dust of phthalic anhydride may be ignited under appropriate conditions.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product and phthalic acid as necessary. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

TECHNIQUE

NEUTRALIZATION. . . Application of an appropriate neutralization agent may modify water containing phthalic acid to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

PHTHALIC ANHYDRIDE
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid phthalic anhydride is heavier than water and slightly soluble therein. Most may be expected to sink to the bottom of a water body and dissolve at a slow yet appreciable rate. Molten phthalic anhydride will solidify upon contact with water and behave similarly.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Hoses and pumps or vacuum trucks may also be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air. Any phthalic acid in recovered materials will corrode some metals while generating hydrogen gas.

MITIGATION

Consult qualified experts for guidance. Use compatible equipment or take other precautions if hydrogen gas may pose a fire or explosion hazard.

TECHNIQUE

CONTAINMENT DIKES . . . Water containing suspended contaminant particles or dissolved contaminants may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

PINE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Pine oil is a colorless to light amber liquid with the penetrating odor of pine. It is used as a wetting or dispersing agent in processing various textiles and paper, and has similar uses in the rubber and dye industries. It is also used as a flotation agent in metallurgical operations and for making soaps, polishes, deodorants, coatings, insecticides, and disinfectants. The product is lighter than water and practically insoluble, so may be expected to form a floating surface slick. Its flash point is between 100 and 199°F, thus indicating that some amount of preheating may be necessary for the product to be ignited easily. Accumulations of vapor from warmed liquid in confined spaces such as buildings or sewers may result in explosions if ignited. There is some limited potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs 6.8-7.8 pounds per gallon depending on specific composition.

Pine oil does not react with water or many other common materials and is relatively noncorrosive. It is incompatible with strong oxidizing agents, is irritating to the eyes, skin, and mucous membranes, and may be toxic if inhaled or ingested in excess. Note that the composition of pine oil is somewhat variable and that its physical and chemical properties are dependent upon specific composition.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble or very slightly soluble
Solubility in Other Chemicals: Various components of pine oil may be soluble in alcohol, ether, benzene, petroleum ether, etc.
Specific Gravity (Liquid): 0.81-0.94
Boiling Point: 367-439°F (186-226°C)
Melting Point: Unavailable
Freezing Point: Unavailable
Molecular Weight: 154.25 for primary component (alpha-terpineol)
Heat of Combustion: Unavailable
Vapor Pressure: Unavailable
Flash Point: Between 100-199°F (37.8-92.8°C)
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Assumed to be stable
Corrosiveness: Assumed to be noncorrosive
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizers.

IDENTIFICATION

Shipping Names: Pine oil (USDOT and IMO)
Synonyms and Tradenames: Oil of pine; synthetic pine oil; deumabietis, oil of five-Siberian; Yarmar.
Chemical Formula: Mixture, primarily $C_{10}H_{17}OH$
Constituent Components(o each): Typically 65-70% alpha-terpineol; 10% dihydro-alpha-terpineol and other tertiary alcohols; 10-15% borneol and fenchyl alcohols, 5% estragole, and 5-10% ketones.
UN/NA Designation: UN1272
IMO Designation: 3.3, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to light amber
Odor Characteristics: Penetrating, like pine
Common Uses: Wetting, dispersing and antibacterial agent in processing cotton,silk, rayon, and wool; wetting or leveling agent in paper, rubber, and dye industries; flotation agent; used to make soaps, polishes, deodorants, coatings,insecticides, and disinfectants.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PINE OIL

Class 3 (Flammable Liquid) or
Combustible Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Combustible liquid that is a weak allergen and may induce allergic reactions.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Available data are limited. It appears that pine oil is an irritant and may be toxic if inhaled or ingested in excess. The NFPA considers health hazards to be low. Others report the product may be a weak allergen.

Hazards of Skin or Eye Contact: Pine oil is expected to be irritating to the skin and eyes.

Hazards of Inhalation: Vapors of pine oil may be irritating to the eyes and mucous membranes. Excessive exposures may possibly result in depression of the central nervous system and respiratory failure.

Hazards of Ingestion: Ingestion of pine oil may cause hemorrhagic gastritis and possibly central nervous system depression, hypothermia, and respiratory failure.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Combustible liquid. Will burn but may be difficult to ignite. There is some limited potential that containers may rupture violently in fire. May generate flammable vapors upon release if heated.

Hazardous Combustion Products: Unknown, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of heated liquid are ignited in a confined area. There is some limited potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include polyethylene, polyvinyl alcohol, and vinyl.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or mucous membranes; weakness or other symptoms of exposure.

First Aid for Inhalation:Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

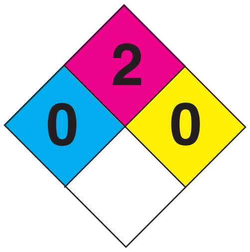
First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: Data unavailable. Get medical attention immediately.

1272

PINE OIL

Class 3 (Flammable Liquid) or Combustible Liquid



FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of pine oil may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that pine oil is a combustible liquid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Pine oil may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of pine oil in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to pine oil vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of pine oil from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of pine oil vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if response is ineffective.

PINE OIL
Class 3 (Flammable Liquid) or Combustible Liquid

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Pine oil may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained pine oil may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

PINE OIL

Class 3 (Flammable Liquid) or Combustible Liquid

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECNNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating pine oil.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

PINE OIL
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with pine oil may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

January 1988

POTASSIUM HYDROXIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Potassium hydroxide, also known as caustic potash, is a white odorless and nonvolatile solid that may be shipped in flake, bead, or granular form or dissolved in water as a colorless solution. It is used in electroplating, lithography, printing, and veterinary medicine; for making soap, wood mordant, and paint and varnish removers; and for mercerizing cotton. It is very soluble in water and will dissolve rapidly with the evolution of considerable heat that may generate steam and spattering. Although the product is not flammable, the heat generated by the solid upon contact with moisture may be sufficient to ignite adjacent combustible materials. Flammable and potentially explosive hydrogen gas may be generated upon contact of the wet product with such metals as aluminum, tin, lead, or zinc. The solid weighs approximately 127.3 pounds per cubic foot. Solutions weigh about 12.8 pounds per gallon.

Potassium hydroxide is stable in normal transportation. It is reactive with a variety of chemicals, and corrosive to various metals and bodily tissues. The solid may absorb moisture from the air and dissolve.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 107 g/100 g water at 59°F (15°C)

Solubility in Other Chemicals: Soluble in alcohol

Specific Gravity (Solid): 2.04 at 59°F (15°C); **(Solutions):** 1.45–1.50 at 68°F (20°C)

Boiling Point: Very high for solid; 293°F (145°C) for 50% solution

Melting Point: See freezing point

Freezing Point: 716°F (380°C) for solid; –45°F (–43°C) for 50% solution

Molecular Weight: 56.11

Heat of Combustion: Not flammable

Vapor Pressure: Negligible; 1 mm Hg (0.0193 psia) at 1326°F (719°C) for solid.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: Will attack wool, leather, aluminum, lead, tin, and zinc. Practically noncorrosive to iron or rubber.

Reactivity with Water: Dissolves with liberation of much heat, may steam and spatter. Solution is basic (alkaline).

Reactivity with Other Chemicals: Reacts with acetic acid, acrolein, acrylonitrile, chlorine dioxide, chloroform and methyl alcohol, 1,2-dichloroethylene, maleic anhydride, nitroethane, nitrogen trichloride, nitromethane, and trichloroethylene. Separate from acids, metals, explosives, organic peroxides, and easily ignitable materials.

IDENTIFICATION

Shipping Names: Potassium hydroxide, dry solid, flake, bead, or granular (USDOT); potassium hydroxide, liquid or solution (USDOT); caustic potash, dry, solid, flake, bead, or granular (USDOT); caustic potash, liquid or solution (USDOT); potassium hydroxide, solid or solution (IMO); caustic potash (IMO); caustic potash, solid (IMO).

Synonyms and Tradenames: Caustic potash; lye; potassium hydrate; potassa; KOH.

Chemical Formula: KOH

Constituent Components (% each): Solid is 83–90% KOH with 2–3% potassium carbonate and rest water; solutions are 45–50% KOH in water.

49 STCC: 49 352 25 (solid); 49 352 30 (solution); 49 352 44 (solution)

UN/NA Designation: UN1813 (solid); UN1814 (solution)

IMO Designation: 8, corrosive

Physical State as Shipped: Solid or liquid solution

Physical State as Released: Solid or liquid solution

Color of the Shipped Material: White solid; colorless solution

Odor Characteristics: Odorless

Common Uses: Electroplating; lithography; printing; veterinary medicine; mercerizing cotton; mfg. soap, wood mordant, and paint. and varnish removers.

POTASSIUM HYDROXIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Evolves considerable heat in reaction with water when solid. Heat may ignite combustible materials. Reaction with some metals evolves hydrogen gas.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 2 mg/m^3 over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Contact with incompatible materials; fire or sparks where hydrogen may be present; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact with solid potassium hydroxide or concentrated solutions may result in severe burns of the skin or eyes.

Hazards of Inhalation: Breathing dust from the solid or concentrated mists in air may result in irritation of the upper respiratory tract, inflammation of the lungs, and possibly pneumonitis.

Hazards of Ingestion: Ingestion may cause burns of the mouth, throat and stomach, nausea, bloody vomit, abdominal pain, perforation of the intestinal tract, diarrhea, and possibly edema of the larynx, suffocation, and death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: No special hazards apparent. Some remote chance that containers may rupture in fire due to steam pressure.

Hazardous Combustion Products: Unlikely

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Contact with metals may generate hydrogen gas that may explode if ignited in confined spaces. Some remote chance that containers may rupture in fire due to steam pressure.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing for solids or liquids (as appropriate). Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high dust or mist concentrations in air. Compatible materials may include butyl rubber, natural rubber, neoprene, neoprene/styrene-butadiene rubber, nitrile rubber, polyethylene, polyvinyl chloride, styrene-butadiene rubber, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 mg/m^3) a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency mist and particulate filter respirator with a full facepiece within the use limitations of such devices. (Note: Respiratory protection may not be required for solutions in the absence of airborne mists.)

1813

POTASSIUM HYDROXIDE

Class 8 (Corrosive Material)

FIRST AID

Nonspecific symptoms: Irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but note that much heat is evolved when water contacts solid product. NFPA suggests flooding with water, using care not to spatter or splash the product.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources where hydrogen may be present. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that contact of wet potassium hydroxide with some metals may generate hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Note that the heat of reaction of the solid with water may be sufficient to ignite some combustible materials.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Potassium hydroxide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed. (Note: Solutions do not pose a problem unless an airborne mist is somehow generated.)

CONSEQUENCE

Hazardous levels of potassium hydroxide in air may be found in the local spill area and immediately downwind, especially if dry solid has spilled on a windy day.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid potassium hydroxide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

POTASSIUM HYDROXIDE
Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Potassium hydroxide solutions or dry product may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials. Keep solid product dry.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION ....Spreading of potassium hydroxide may be controlled by absoring liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Although sorbents will immobilize the spill and help control spreading, they do not alter the hazardous nature of the spilled product. Their use adds to the volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by.mechanical means. Where necessary, neutralize sorbents under guidance of qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

POTASSIUM HYDROXIDE
Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause potassium hydroxide dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

POTASSIUM NITRATE
Division 5.1 (Oxidizer)

GENERAL INFORMATION

Potassium nitrate is a white crystalline solid that is odorless and is used in solid rocket propellants, explosives, fertilizers, meat processing, and a variety of other products and processes. It is moderately soluble in water and heavier, so may be expected to sink and dissolve fairly rapidly. The substance is not flammable but is a strong oxidizer that may react with easily oxidizable materials to cause ignition, violent combustion, or explosion. It may also accelerate the burning of any combustible material. One authority suggests that an explosion may result if potassium nitrate is involved in a fire. The product weighs approximately 131.6 pounds per cubic foot.

Potassium nitrate is stable in normal transportation and does not react with water. It is reactive with a variety of chemicals, and as noted above, may form potentially explosive mixtures. Toxicity is apparently relatively low by the various potential routes of exposure, but the product evolves toxic nitrogen oxide gases when involved in a fire.

If a fire involving bulk amounts of potassium nitrate becomes uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from the effects of potential explosions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 13.3–247 g/100 g water in range 32–212°F (0–100°C)
Solubility in Other Chemicals: Soluble in liquid ammonia and glycerine
Specific Gravity (Solid): 2.109 at 60.8°F (16°C)
Boiling Point: Decomposes at 752°F (400°C)
Melting Point: 633°F (334°C)
Freezing Point: See melting point
Molecular Weight: *101.11*
Heat of Combustion: Not flammable
Vapor Pressure: *Low*
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable *Stability:* Stable
Corrosiveness: Data unavailable
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with oxidizable materials; mixtures with reducing agents may explode under heat or shock as may mixtures with sodium acetate and tartarates, oxalates and citrates, sodium or lead phosphite, tin solder, tin plate, stannates, or lead nitrite.

IDENTIFICATION

Shipping Names: Potassium nitrate (USDOT and IMO)
Synonyms and Tradenames: Nitric acid, potassium salt; saltpeter; niter; nitre.
Chemical Formula: $KN0_3$
Constituent Components(% each): Relatively pure
49 STCC: 49 187 37
UN/NA Designation: UN1486
IMO Designation: 5.1, oxidizing substance
Physical State as Shipped: Solid crystals or powder
Physical State as Released: Solid crystals or powder
Color of the Shipped Material: White
Odor Characteristics: Odorless
Common Uses: Solid rocket propellants; explosives; fertilizers; metal heat treatment agents; glass clarifier; pharmaceuticals; metallurgy; meat processing.

POTASSIUM NITRATE
Division 5.1 (Oxidizer)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Strong oxidizer that may ignite or form potentially explosive mixtures with reducing agents, oxidizable materials, and certain other chemicals. May explode if heated.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Potassium nitrate is apparently considered to be of low toxic hazard in normal handling. Limited data are available.

Hazards of Skin or Eye Contact: Contact with potassium nitrate may result in irritation of the skin or eyes.

Hazards of Inhalation: Breathing potassium nitrate dust may cause irritation of the mucous membranes.

Hazards of Ingestion: Ingestion of significant amounts of potassium nitrate may result in nausea, diarrhea, increased urination, muscular debility, collapse, and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May accelerate burning of combustible materials. May fuse or melt. One authority suggests that containers may explode in fire.

Hazardous Combustion Products: Include toxic oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: Not pertinent

Upper Explosive Limit: Not pertinent

Explosiveness: Contact with certain other chemicals or oxidizable materials may result in formation of explosive mixtures (see Reactivity with Other Chemicals). Potassium nitrate may explode in fires.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For fire fighting, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For normal handling where dust is airborne, an approved dust mask may be adequate within the use limitations of such devices.

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or mucous membranes.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Get medical attention.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If victim conscious administer large quantities of water and immediately induce vomiting. Never give anything by mouth to an unconscious person. Never try to make unconscious person vomit. Get medical attention immediately.

1486

POTASSIUM NITRATE
Division 5.1 (Oxidizer)

FIRE RESPONSE

Extinguishing Materials: Flood with water, but note that large quantities of potassium nitrate may melt or fuse in fire and that water application may result in extensive scattering of molten material.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture or explosion potential. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Avoid contact with spilled product. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in corrosion of boilers or industrial process equipment. Take into account while planning the response that potassium nitrate is a strong oxidizer.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Potassium nitrate should not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of potassium nitrate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Protect product from wind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid potassium nitrate with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Potassium nitrate may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Water solutions of potassium nitrate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination.

POTASSIUM NITRATE
Division 5.1 (Oxidizer)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause potassium nitrate dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize airborne dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

January 1992

n-PROPANOL
Class 3 (Flammable Liquid)

GENERAL INFORMATION

n-Propanol, also transported with the proper shipping names "propyl alcohol normal" or "propyl alcohol", is a fairly volatile colorless liquid with a pleasant, sweet odor resembling ethyl alcohol. It is widely used as a solvent and extractant in industry and as a raw material for making other chemicals and numerous commercial products. The substance is fully soluble in water and will mix freely. Its flash point range of 71 to 84°F indicates that it may be easily ignited under moderate to high ambient temperature conditions or when heated by some means. At temperatures above its flash point, vapors of the liquid may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited under such conditions. Containers of liquid have some limited potential to rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.7 pounds per gallon. Liquid n-Propanol does not react with water or other common materials and is stable in normal transportation. It is a relatively noncorrosive substance but may attack some forms of plastics, rubber and coatings.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in acetone, alcohols, benzene, ethers, propylene glycol, and many other solvents.

Specific Gravity (Liquid): 0.803-0.806 at 68°F (20°C)

Boiling Point: 207 - 208°F (97.2 - 97.8°C) at 1 atm.

Melting Point: - 196.6 to - 195.2°F (- 127 to - 126.2°C)

Freezing Point: See melting point

Molecular Weight: 60.1

Heat of Combustion: - 7296 cal/g

Vapor Pressure: Most sources report 14.5 - 15.0 mm Hg (0.2803 - 0.2899 psia) at 68°F (20°C); one maker reports 13 mm Hg (0.2513 psia) at this temperature for its product. Other values include 5 mm Hg (0.0966 psia) at 41°F (5°C) and 60 mm Hg (1.160 psia) at 110.3°F (43.5°C).

Flash Point: 71 - 77°F (21.7 - 25.9°C), closed-cup; 77 - 84°F (25 - 28.9°C), open-cup.

Autoignition Temperature: 700, 775, or 824°F (371, 413, or 440°C); reported values vary.

Burning Rate: 2.9 mm/minute

Stability: Stable

Corrosiveness: Reported as not corrosive to common metals. May attack some forms of plastics, rubber, and coatings. Similar alcohols are reported to react with metallic aluminum at high temperatures.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Various sources list incompatible materials as including strong oxidizing agents (which are said to increase the risk of fire or explosion), strong acids (including nitric acid and sulfuric acid), aldehydes, halogens, and active halogen compounds.

IDENTIFICATION

Shipping Names: n-Propanol; propyl alcohol normal; propyl alcohol

Synonyms and Tradenames: Ethyl carbinol; 1-hydroxypropane; normal propanol; normal propyl alcohol; propanol; n-propyl alcohol; 1-propanol; propanol-1; 1-propyl alcohol; propylic alcohol; and various tradenames.

Chemical Formula: $CH_3CH_2CH_2OH$

Constituent Components (% each): As best as can be determined, the product is generally 95% or more pure. Some grades are 99.8% or more pure.

49 STCC: 49 092 67

UN/NA Designation: UN1274

IMO Designation: 3, flammable liquid

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Clear, colorless liquid

Odor Characteristics: Pleasant or sweet; mild alcohol odor; resembles odor of ethyl alcohol (ethanol).

Common Uses: Solvent for printing inks, natural or synthetic gums and resins, rosin, shellac, insecticides, waxes, cellulose esters, nail polishes, and other products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

n-PROPANOL
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Many respected sources of information suggest that the odor of n-propanol can be detected and/or recognized in the range of 30 to 45 ppm in air. Overall, threshold odor concentrations reported in the literature range from a small fraction of 1 ppm to about 80 ppm.

Unusual Hazards: Somewhat volatile flammable liquid. Rather typical of a simple alcohol in properties and hazards.

Short Term Exposure Limit (STEL): (Skin) 250 ppm for 15 minutes (ACGIH, 1991-92; OSHA, 1989).

Time Weighted Average (TWA) Limit: (Skin) 200 ppm over each 8 hours of a 40 hour work week (ACGIH, 1991 - 92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard in spill situations is from exposure to the high vapor concentrations of n-propanol vapors in air that may be present in the spill area and over some distance downwind. Ingestion and physical contact should also be avoided.

Hazards of Skin or Eye Contact: High concentrations of n-propanol vapors in air cause irritation of the eyes. Contact of liquid n-propanol with the eyes may cause moderate to severe irritation, redness, inflammation, pain, lacrimation, corneal opacities, blurred vision, and possibly corneal burns or ulcerations.

Hazards of Inhalation: The vapors of n-propanol may cause irritation of the nose and throat. High concentrations in air may cause narcosis and central nervous system depression with symptoms including drowsiness, dizziness, weakness, fatigue, headache, nausea, stupor, incoordination, prostration, unconsciousness, and even death in extreme cases.

Hazards of Ingestion: n-Propanol is of comparatively low toxicity by ingestion. Nevertheless, ingestion of sufficient amounts may variably cause dizziness, drowsiness, headache, incoordination, stupor, nausea, vomiting, gastrointestinal irritation and pain, cramps, diarrhea, paralysis, reduced respiration and body temperature, unconsciousness, coma, and even death in severe cases. The single oral dose reported to kill a human woman was 5.7 grams per kilogram of body weight (over half pound of the alcohol for a 110 lb person).

FIRE HAZARDS

Lower Flammable Limit: 2 - 2.2%

Upper Flammable Limit: 12 - 14%

Behavior in Fire: Flammable liquid. May generate flammable vapors when at temperatures at or above its flash point. Such vapors may travel some distance to a source of ignition and flash back. There is some limited potential for containers to rupture violently and possibly rocket in fires.

Hazardous Combustion Products: Not well-defined; may include carbon monoxide, carbon dioxide, and other toxic constituents. One authority reports that n-propanol evolves acrid smoke and irritating fumes when heated to decomposition.

EXPLOSION HAZARDS

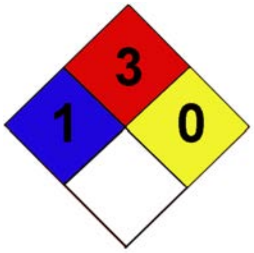
Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from liquid n-propanol at or above its flash point are ignited in a confined area. There is some limited potential for containers to rupture violently and possibly rocket in fires.

1274

n-PROPANOL
Class 3 (Flammable Liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, butyl rubber/neoprene, neoprene, neoprene/styrene-butadiene rubber (SBR), nitrile rubber, polyurethane, polyvinyl acetate, SBR, SBR/neoprene, teflon, Viton, and Viton/neoprene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 4000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (for levels of 4000 ppm or less) or a chemical cartridge respirator with organic vapor cartridge(s) with a full facepiece (for levels of 1000 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, or upper respiratory tract; drowsiness, dizziness, headache, nausea, stupor, or other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs naturally, have the victim lean forward with head below hips to reduce the risk of aspiration of fluids into the lungs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or promptly if skin irritation persists after washing.

First Aid for Ingestion: If conscious, have victim rinse mouth thoroughly with water and then administer several glasses of water to dilute material in stomach. Get medical attention immediately. If qualified medical attention is not immediately available, a significant quantity of n-propanol has been ingested, and the victim is still conscious, induce vomiting and then give water again. Do not make an unconscious person vomit. Whether vomiting occurs naturally or is induced, have victim lean forward with head below hips to reduce the risk of aspiration of fluids into the lungs. (Note: Authorities consulted had several different opinions on the proper course of action in the event of ingestion. The above recommendation is a compromise position that gives special attention to reducing the risk of aspiration into the lungs yet recognizes that ingestion of a large quantity of n-propanol can have rapid and significant effects. Seek advice from a physician on how to proceed, if rapid communication is possible, before implementing the recommended response.)

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, alcohol foam. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind.. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

n-PROPANOL
Class 3 (Flammable Liquid)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Take the volatility, flammability, and toxicity of n-propanol into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. n-Propanol discharges may expose downwind areas to toxic and flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm or hot weather or the liquid is somehow heated.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION . . . Liquid n-propanol may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled or in cold weather.

CONSEQUENCE

Hazardous levels of n-propanol in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to n-propanol in air may absorb vapors as well as accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of n-propanol from contact with its vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

n-PROPANOL
Class 3 (Flammable Liquid)

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid n-propanol may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of n-propanol vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid n-propanol may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

n-PROPANOL
Class 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of afire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Propionaldehyde is a colorless liquid with a pungent, suffocating, and overpoweringly fruity odor. It is used to make plastics, rubber chemicals, disinfectants, and preservatives. It is quite soluble in water and will rapidly dissolve. Its lowest reported flash point of - 22°F (15 - 19°F also reported) indicates the product is easily ignited under a wide range of ambient temperature conditions. A boiling of 118.4°F and a significant vapor pressure indicate that the substance is quite volatile. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 6.7 pounds per gallon.

Propionaldehyde does not react with water or many other common materials and is stable in normal transportation. It is vigorously reactive with oxidizing materials, however, and may self-polymerize (possibly violently) in the presence of acids or caustics. Toxicity of the product is low to moderate by the various potential routes of exposure but high concentrations may be present in air. Products of combustion may include toxic constituents.

Downwind evacuation should be considered if propionaldehyde is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 21 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in diethyl ether and ethyl alcohol.
Specific Gravity (Liquid): 0.805 at 68°F (20°C)
Boiling Point: 118.4°F (48°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: - 112°F (- 80°C)
Molecular Weight: 58.08
Heat of Combustion: - 6930 cal/g
Vapor Pressure: 235 mm Hg (4.54 psia) at 68°F (20°C)
Flash Point: Min. - 22°F (- 30°C); max. 15 - 19°F (- 9.4 to - 7.2°C); open cup.
Autoignition Temperature: 405°F (207°C)
Burning Rate: 4.4 mm/minute
Stability: Stable
Corrosiveness: Relatively noncorrosive. Compatible with stainless steel and aluminum.
Reactivity with Water: *No* reaction
Reactivity with Other Chemicals: Reacts vigorously with oxidizers. May self-polymerize in the presence of acids or caustics.

IDENTIFICATION

Shipping Names: Propionaldehyde (USDOT and IMO)
Synonyms and Tradenames: Propyl aldehyde; propanal; propionic aldehyde; methyl acetaldehyde; propional; propylic aldehyde.
Chemical Formula: CH_3CH_2CHO
Constituent Components(% each): 97 - 99% or more pure
49 STCC: 49 082 70
UN/NA Designation: UN1275
Uses: Mfg. plastics, rubber chemicals, disinfectants, and preservatives.
IMO Designation: 3.1 or 3.2, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent, suffocating, overpoweringly fruity.
Common

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.009 ppm (absolute perception limit)

Unusual Hazards: Volatile flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. May self-polymerize in the presence of acids or caustics.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the high vapor concentrations that may be present in the local spill area and some distance downwind. Ingestion and direct contact are also to be avoided.

Hazards of Skin or Eye Contact: Contact with liquid propionaldehyde may cause irritation and inflammation of the skin or eyes. Based on data for similar aldehydes, there is a possibility that some degree of eye injury may occur.

Hazards of Inhalation: Vapors of propionaldehyde are severely irritating to the eyes, nose, and mucous membranes. High concentrations in air may cause coughing, lung congestion, drowsiness, lethargy, some incoordination, nausea, and vomiting. Saturated vapors in air were lethal to rats within two minutes in laboratory experiments. Exposure to 8000 ppm killed most rats in four hours. One authority indicates that 200 ppm is the maximum allowable concentration for humans.

Hazards of Ingestion: Ingestion may result in nausea, vomiting, diarrhea, drowsiness, lethargy, some incoordination, and possibly respiratory failure.

FIRE HAZARDS

Lower Flammable Limit: 2.6 - 2.9%

Upper Flammable Limit: 16.1 - 17%

Behavior in Fire: Flammable liquid. Will generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Acids or caustics may initiate possibly violent polymerization that may result in container rupture.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, polyethylene, polyurethane, polyvinyl chloride, styrene-butadiene rubber, and nitrite-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1275

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific symptoms: Irritation of eyes, skin, nose, or mucous membranes; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Get medical attention immediately. (Note: First aid procedures for ingestion are not well documented. Contact a physician for advice and treatment as soon as possible.)

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, alcohol foam, water spray. Water may be ineffective but may be used to dilute spills to nonflammable mixture.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the volatility, flammability, and toxicity of propionaldehyde into account while planning the response. (Note: In some rare spills, there may be time to apply oil spill containment and cleanup techniques to propionaldehyde floating on water before the chemical dissolves. This guide presumes that dissolution will be rapid.) Note that the product may polymerize under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Propionaldehyde spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large amounts have spilled.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

MONITOR THE SITUATION... Propionaldehyde may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if small amounts have spilled in cold weather.

CONSEQUENCE

Hazardous levels of propionaldehyde in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may absorb propionaldehyde vapors and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of propionaldehyde from contact with its vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid propionaldehyde may slow the release of vapors into the atmosphere. (Note: All propionaldehyde must be dissolved in water.)

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of propionaldehyde vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Propionaldehyde may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained propionaldehyde may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL.. . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

PROPIONALDEHYDE
Class 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

PROPIONIC ACID
Class 8 (Corrosive Material)

GENERAL INFORMATION

Propionic acid is a colorless oily liquid with a sharp, rancid, acrid and irritating odor. It is used for making preservatives and fungicides, herbicides, emulsifying agents, perfumes, artificial flavors, pharmaceuticals, plastics, and other chemicals and products. It is fully soluble with water. The 126-130°F flash point of the product indicates that propionic acid must be moderately heated or exposed to very high ambient temperatures before ignition may occur easily. Accumulations of vapors from warmed liquid in confined spaces such as sewers or buildings may result in explosions if ignited. Containers have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.3 pounds per gallon.

Propionic acid does not react with water and is stable in normal transportation. Reactions with alcohols, glycols, aldehydes, epoxides, explosives, or polymerizable compounds may be violent or explosive, and the acid is reactive with a variety of other chemicals. It corrodes ordinary steel and many other metals in a reaction that is not hazardous. Vapors are highly irritating and the liquid may have a corrosive effect on eyes, skin and mucous membranes when concentrated. Products of combustion may include irritating fumes of unburned acid and toxic constituents.

Downwind evacuations should be considered on a case by case basis if propionic acid is leaking but not on fire.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in alcohol, chloroform, ether, and inert organic solvents.

Specific Gravity (Liquid): 0.992 - 0.997 at 68°F (20°C)

Boiling Point: 285.3-286.5°F (140.7 - 141.4°C) at 1 atm.

Melting Point: - 5.4°F (-20.8°C) to - 7.6°F (- 22°C)

Freezing Point: - 5.4°F (- 20.8°C) to - 8.3°F (- 22.4°C)

Molecular Weight: 74.08

Heat of Combustion: - 4935 cal/g

Vapor Pressure: 2.4 - 3.0 mm Hg (0.046 - 0.058 Asia) at 68°F (20°C)

Flash Point: 126-130°F (52.2 - 54.4°C), closed cup; 130 - 134°F (54.4 - 56.7°C), open cup.

Autoignition Temperature: min. 870°F (466°C); max. 1105°F (596°C); reported values vary

Burning Rate: 2.2 mm/minute (undiluted)

Stability: Stable

Corrosiveness: Corrodes ordinary steel and many other metals. Carbon steel, brass, or bronze not acceptable from color and contamination standpoint.

Reactivity with Water: *No* reaction

Reactivity with Other Chemicals: Reacts with oxidizing agents, alkalies, mineral acids, azo and diazo compounds, hydrazines, isocyanates, amines, caustics, nitrites, alcohols, glycols, aldehydes, epoxides, polymerizable compounds, strong reducing agents, nitrides, cyanide, dithiocarbamates, inorganic fluorides or sulfides, alkaline earth elemental metals, and explosives.

IDENTIFICATION

Shipping Names: Propionic acid (USDOT or IMO); propionic acid solution (USDOT).

Synonyms and Tradenames: Propanoic acid, methylacetic acid; ethane carboxylic acid; carboxyethane; ethylformic acid; metacetonic acid; prozoin; pseudoacetic acid; sentry grain preserver; Tenox P grain preservative.

Chemical Formula: CH_3CH_2COOH

Constituent Components (% each): 99+% for technical grade; may also be water solution

49 STCC: 49 314 48 (undiluted); 49 314 47 (solution)

UN/NA Designation: UN1848

IMO Designation: 8, corrosive

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Acrid, sour, sharp, rancid, irritating.

Common Uses: Grain and wood chip preservative; electroplating solutions; mfg. of mold inhibitors, fungicides, herbicides, emulsifying agents, perfumes, artificial fruit flavors, pharmaceuticals, plastics, and other chemicals.

PROPIONIC ACID
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 5.8-34 ppb

Unusual Hazards: Combustible liquid with irritating vapors and a corrosive effect on tissue.

Short Term Exposure Limits (STEL): 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 10 ppm over each *8* hours of a *40* hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazards are from inhalation of irritating vapors and physical contact with corrosive liquid. The product is not highly volatile.

Hazards of Skin or Eye Contact: Liquid propionic acid is a skin irritant with the potential to cause moderate to severe damage or burns after short contact. Contact with the eyes may cause severe irritation, redness, tearing, blurred vision, and possible necrosis.

Hazards of Inhalation: Vapors of propionic acid are highly irritating to the eyes, nose, and respiratory tract.

Hazards of Ingestion: Propionic acid may cause severe damage to mucous membranes when concentrated but is not very toxic when dilute. Swiss cheese may contain up to 1% of this chemical.

FIRE HAZARDS

***Lower Flammable Limit*:** 2.9-3.7%

Upper Flammable Limit: 12.1-14.8%

Behavior in Fire: Combustible liquid. Will burn but difficult to ignite unless heated. There is some limited potential that containers may rupture violently in fire.

Hazardous Combustion Products: Irritating fumes of unburned acid and possibly other toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors of warmed liquid are ignited in a confined area. There is some limited potential that containers may rupture violently in fire. Reactions with various other chemicals may be explosive (see General Information section).

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For short-term low-level exposure, a gas mask with chin-style or front or back mounted canister or a chemical cartridge respirator with a full facepiece within the use limitations of these devices. The canister or cartridge should provide protection from propionic acid.

FIRST AID

Nonspecific symptoms: Irritation of eyes, nose, or respiratory tract due to vapor exposure. Irritation or burns due to ingestion or physical contact with liquid.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

1848

PROPIONIC ACID
Class 8 (Corrosive Material)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, dry chemical, carbon dioxide. Water spray may be used for dilution to nonflammable concentration.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Eliminate ignition sources. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the reactivity of propionic acid into account while planning the response.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION... Propionic acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of propionic acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Propionic acid spills may expose downwind areas to toxic or flammable concentrations, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to propionic acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain propionic acid from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

PROPIONIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of propionic acid vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

J Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid propionic acid may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid propionic acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES. . . Propionic acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained propionic acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Reinforce diked walls as needed.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

PROPIONIC ACID
Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES. . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

PROPIONIC ACID
Class 3 (Flammable Liquid)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Neutralize to pH 7 before applying carbon.)

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

March 1995

PROPYL ACETATE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Propyl acetate is a colorless liquid with a pleasant, mild fruity odor like pears. It is used as a solvent and has uses in flavoring agents, perfumes, adhesives, plastics, resins, lacquers, and other products, as well as for making other chemicals. Slightly soluble in water and lighter, propyl acetate will float to form a surface slick that slowly dissolves. Its flash point of 55-58°F indicates that it can easily be ignited under many ambient temperature conditions. At warmer temperatures, vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. There is some potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.1-7.4 pounds per gallon.

Propyl acetate does not react with water or many other common materials but will attack various plastics and resins and react with a variety of other chemicals. It is stable in normal transportation and of low to moderate toxicity via the various potential routes of exposure. Products of combustion may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 1.89 g/100 g water (2.3%W) at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohols, esters, ether, hydrocarbons, and ketones.

Specific Gravity (Liquid): 0.855-0.887 at 68°F (20°C)

Boiling Point: 204.8-215.6°F (96-102°C) at 1 atm.

Melting Point: –134.5 or –139.9°F (– 92.5 to – 95°C)

Freezing Point: – 133.6 to – 135.4°F (– 92 to – 93°C)

Molecular Weight: 102.13

Heat of Combustion: Unavailable

Vapor Pressure: 23-24.9 mm Hg (0.445-0.481 psia) at 68°F (20°C)

Flash Point: 55-58°F (13-14.4°C), closed cup; 58-70°F (14.4-21.1°C), open cup.

Autoignition Temperature: 842-855°F (450-457°C)

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: Brass, bronze, or lead compounds not acceptable from a color or contamination standpoint. Will attack many plastics and resins. Carbon steel, 304SS, lined carbon steel, or aluminum not attacked.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Reacts with nitrates, strong oxidizers, inorganic acids, alkali, strong reducing agents, explosives, alkaline earth elemental metals, nitrides, azo and diazo compounds, hydrazines, and caustics.

IDENTIFICATION

Shipping Names: nPropyl acetate (USDOT & IMO)

Synonyms and Tradenames: Acetic acid, propyl ester; n-propyl acetate; 1-acetoxypropane; 1-propyl acetate.

Chemical Formula: $CH_3COOCH_2CH_2CH_3$

Constituent Components(% each): 90-100% pure

UN/NA Designation: UN1276

IMO Designation: 3.2, flammable liquid

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant; mild fruity; pear odor

Common Uses: Solvent for nitrocellulose and cellulose derivatives, resins, lacquers, printing inks, adhesives, mfg. of perfumes, flavoring agents, plastics, other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

PROPYL ACETATE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: 20 ppm, but could be as low as 0.05-0.15 ppm according to some authorities.

Unusual Hazards: Moderately volatile flammable liquid. Vapors may be heavier than air and travel to a source of ignition.

Short Term Exposure Limits(STEL): 250 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 200 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air, as may occur in the immediate vicinity and directly downwind of a spill.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid propyl acetate may result in drying and cracking of the skin. Contact with the eyes may cause irritation with redness and tearing.

Hazards of Inhalation: Vapors are irritating to the eyes, nose, and respiratory tract. High concentrations in air may be narcotic with symptoms including dizziness, weakness, fatigue, nausea, headache, loss of consciousness, and possibly death. Exposure to 24,500 ppm for 30 minutes is lethal to cats. Repeated exposure to 5300 ppm causes eye irritation and salivation.

Hazards of Ingestion: Ingestion of propyl acetate may cause gastrointestinal irritation, nausea, vomiting, diarrhea, headache, drowsiness, and unconsciousness.

FIRE HAZARDS

Lower Flammable Limit: 1.7-2%

Upper Flammable Limit: 8%

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire.

Hazardous Combustion Products: Not well-defined, may include toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. There is some potential that containers may rupture violently in fire.

PROTECTIVE CLOTHING AND EQUIPMENT

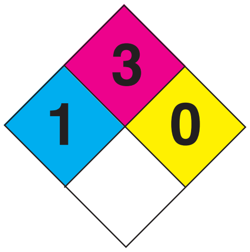
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include neoprene, polyvinyl alcohol, butyl rubber, polyethylene, polyurethane, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 8000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (8000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

1276

PROPYL ACETATE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes and nose or other symptoms of vapor exposure or ingestion. Eye or skin irritation from direct physical contact.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if irritation persists after washing of skin.

First Aid for Ingestion: If victim is conscious, administer two glasses of water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Water spray, alcohol foam, dry chemical, carbon dioxide. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of propyl acetate may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that propyl acetate is a flammable liquid.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Propyl acetate spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Propyl acetate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of propyl acetate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

PROPYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to propyl acetate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of propyl acetate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of propyl acetate vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Propyl acetate may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained proply acetate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

PROPYL ACETATE
Class 3 (Flammable Liquid)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across steam and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled products.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment. The technique will not be effective for propyl acetate that has dissolved in water.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow of dam or water body boundaries. The spilled product may all dissolve in water before the dam in completed.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

PROPYL ACETATE

Class 3 (Flammable Liquid)

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating propyl acetate before it dissolves in water.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with propyl acetate may be used to absorb spilled product from the water surface, preferably after the spill has been contained but before proply acetate dissolves in water.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equlpment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July, 1994

PROPYLAMINE*
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Propylamine is a colorless liquid with a strong ammonia odor. It is lighter than water and completely soluble in water. Liquid propylamine weighs 5.9 lbs/gal.

Propylamine is flammable, heavier than air, and with its low boiling point, can be expected to generate significant quantities of vapor. Propylamine has a very low flash point and is flammable under most circumstances. It is easily ignited by flame, sparks, or static discharges and vapors may travel considerable distances to a source of ignition. Vapors will likely concentrate in low lying areas and, if concentration is sufficient, may represent a potential for ignition and flashback to source. Vapor accumulations in confined areas, such as buildings or sewers, may present an explosion hazard. Aside from its flammability, propylamine is stable and not prone to hazardous polymerization reactions.

On direct contact, propylamine will likely result in strong irritation or burns to the skin, eyes or other mucous membranes. Damage to eyes can be permanent. If vapors are inhaled, they will irritate or burn the respiratory tract.

Propylamine is a chemical intermediate used in the manufacture of rubber processing chemicals, dyes, pharmaceuticals, textile resins, and additives to petroleum products.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Completely soluble.
Solubility in Other Chemicals: Completely soluble in alcohol and ether. Soluble in acetone, benzene, and chloroform.
Specific Gravity (Liquid): 0.718 -0.719
Vapor Density (Air =1): 2.04
Boiling Point: 48 to 49°C (118.4 to 120.2°F)
Melting Point: -83°C (-117.4°F)
Freezing Point: -83°C (-117.4°F)
Molecular Weight: 59.11
Heat of Combustion: -8763 cal/gm
Vapor Pressure: 248 mmHg@ 20°C (68°F)
Flash Point: -37.2°C to 12°C (-34.96 to 10.4°F) CC
Autoignition Temperature: 317°C (602.6°F)
Burning Rate: Unavailable.
Stability: Stable, not subject to polymerization.
Corrosiveness: Alkaline liquid, corrosive to tissues.
Reactivity with Water: Not reactive with water.
Reactivity with Other Chemicals: Reacts with oxidizers and strong acids.

IDENTIFICATION

Shipping Names: Propylamine
Synonyms and Tradenames: 1-Propanamine; I-Aminopropane; CAS 107-10-8.
Chemical Formula: $C_3H_3NH_2$
Constituent Components (% each): 99% propylamine
UN/NA Designation: UN1277
IMO Designation: 3.1, flammable liquid.
Physical State as Shipped: Liquid.
Physical State as Released: Liquid.
Color of the Shipped Material: Colorless.
Odor Characteristics: Strong ammonia odor.
Common Uses: Chemical intermediate, laboratory reagent. Used in the manufacture of pharmaceuticals, rubber processing chemicals, dyes, petroleum additives, and textile resins.

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*Reportable Quantity (RQ) established Refer to appendix 1.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

PROPYLAMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.0089 ppm (0.022 mg/m^3)

Unusual Hazards: Propylamine is a highly flammable liquid. It is a strong irritant to skin and mucous membranes and is toxic by all routes of exposure. When ignited or exposed to heating, the combustion and decomposition products include toxic ammonia. Above the flash point, propylamine is explosive within the limits of flammability.

Short Term Exposure Limits (STEL): None determined.

Time Weighted Average (TLV-TWA): None determined.

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Toxic by ingestion, and to a lesser degree, absorption and inhalation. Irritant to skin and highly irritating to eyes and mucous membranes. Inhalation exposure may result in severe irritation to the respiratory mucous membranes, pulmonary edema, and, in severe cases, chemical pneumonia.

Hazards of Skin and Eye Contact: Liquid exposure to eyes may result in severe irritation and corneal injury. Propylamine may produce permanent eye damage. Vapors may be irritating to eyes. Skin contact may result in severe irritation, redness, blistering or burns. Severity of symptoms will increase with quantity and duration of exposure. Toxic by skin absorption on prolonged contact. May cause headache, nausea, and vomiting.

Hazards of Inhalation: Primarily an irritant to respiratory mucous membranes. Prolonged exposure to excessive vapors may result in varying degrees of respiratory impairment including burning sensation, coughing, wheezing, and shortness of breath. Severe exposures may result in pulmonary edema and chemical pneumonia. Development of pulmonary symptoms may be delayed. Risk of systemic toxicity by inhalation route. Symptoms may include headache, nausea, and vomiting.

Hazards of Ingestion: Severe irritation or burns of the mouth, throat, stomach and associated tissue. May cause nausea, vomiting, and gastrointestinal distress. May also produce symptoms of dizziness, light headedness, and nervousness or anxiety.

FIRE HAZARDS

Lower Flammable Limit: 2.0%

Upper Flammable Limit: 10.4%

Behavior in Fire: Smoke may contain toxic and irritating vapors. Vapors are heavier than air and will tend to collect in confined spaces or low lying areas. Vapor concentrations may present a source for ignition and flashback to the source under circumstances favoring vapor buildup. Sealed containers, exposed to heating may rupture.

Hazardous Combustion Products: Ammonia, unburned product, oxides of carbon and other constituents.

EXPLOSION HAZARDS

Explosiveness: Vapor mixtures within the flammable limits may ignite explosively. Otherwise stable and not subject to violent polymerization.

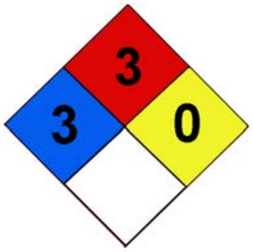
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with propylamine liquid or vapors. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Fully encapsulating suits made of compatible material are appropriate for most large spill situations. Data is limited, however, teflon and chlorinated polyethylene (CPE) compositions have been suggested as suitable materials of construction.

Respiratory Protection: OSHA/NIOSH approved organic vapor cartridge respirators can be used within the limitations of these devices. Positive pressure, self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with large spills.

1277

PROPYLAMINE
Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation or burns to skin, eyes and respiratory tract. Irritation or burns to mouth, throat and stomach, gastrointestinal distress, nausea, vomiting, dizziness and difficulty breathing in cases involving accidental ingestion.

First Aid For Inhalation: Remove victim to fresh air. Remove contaminated clothing and keep victim warm. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure resulting in increased respiratory distress with time. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance immediately. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance if skin irritation persists or exposure is severe.

First Aid for Ingestion: Do not induce vomiting. If victim is conscious, administer large quantities of water or milk. Never give anything by mouth to an unconscious person. Seek medical assistance immediately. Be alert to signs of difficulty in breathing, nervousness, or other indications of systemic toxicity.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, compatible multi-purpose foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective as a firefighting agent but may be used to dilute mixtures to non-flammable concentrations. Diluting with water will add significantly to the spill volume.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with propylamine. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers with water from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank. Water may be ineffective as a suppressent but can be used to dilute mixtures below their flammable range. Carbon dioxide or dry chemical extinguishing agents are suitable for small fires within limitations of the extinguishing system. Alcohol foam is appropriate for fires involving propylamine.

SPILL RESPONSES

General Information: Propylamine is highly flammable and easily ignited. Response strategies should account for the fact that flammable vapors are heavier than air and may travel some distance to a source of ignition. Intact containers containing propylamine may rupture violently if exposed to extreme heat or fire. When spilled in water, propylamine is completely soluble and will tend to disperse in the water column. All spill responses should consider that until the product is removed to safe containers, ignition is possible. Eliminate ignition sources. Notify authorities, downstream of spill, of the potential for contamination. If introduced into sewer system, notify sewer authorities. Notify affected industrial water users of the potential for contamination. If introduced into industrial water intakes, sewage treatment plants and other facilities, ignition of propylamine may result in explosion. Use only spark proof tools when working around propylamine. Be sure lighting systems are of explosion proof design (intrinsically safe). Be alert to sources of ignition and static electrical discharge. Ground all transfer equipment to prevent static charge buildup.

PROPYLAMINE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . .Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Propylamine spills may expose downwind areas to toxic or flammable concentrations over considerable distances, in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY. . .Water fog applied to propylamine vapors or fumes may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain propylamine from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . .Fire fighting or compatible hazardous materials foams applied to the surface of liquid pools may slow the release of propylamine vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As foam breaks down, the release of vapors will increase. Products of foam breakdown will add to the spill volume.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as contaminated with propylamine.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . .Spills of propylamine liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Propylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause impoundments to overflow. Where possible, line containment areas with suitable, impervious material.

PROPYLAMINE
Class 3 (Flammable Liquid)

LAND SPILL *(CONTINUED)*

TECHNIQUE

EXCAVATION . . .A trench or ditch may be excavated to intercept leaking propylamine.

CONSEQUENCE

Propylamine may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . .Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Propylamine is highly flammable and explosion proof (intrinsically safe) equipment must be used.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

Use equipment constructed of compatible materials. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION . . .Spilled propylamine can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with propylamine and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL. . .Spilled propylamine and contaminated soil may be removed by shovels, motorized graders, scrapers, loaders, bulldozers and draglines. Explosion proof (intrinsically safe) equipment must be used due to the high flammability of propylamine.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Removed materials may pose a continued risk of fire or contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Store contaminated materials in a safe and secure location.

PROPYLAMINE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . .Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION . . .Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels..

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

March 1995

PROPYLENE

Class 2.1 (Flammable Gas)

GENERAL INFORMATION

Propylene, which may be also transported in the U.S. with the shipping name “liquefied petroleum gas” or LPG for short, is a colorless and flammable liquefied gas with a boiling point of approximately 53.9°F in the open environment. It has an odor like petroleum when pure but shipments may be treated at times with a foul (skunk-like) additive for leakage warning purposes. The substance is used as an aerosol propellant and to make resins, gasoline components polypropylene plastic, synthetic rubber, and a wide variety of other chemicals.

Propylene is practically insoluble in water and lighter. Due to its very low boiling point temperature, any spilled liquid will rapidly boil from ground or water surfaces under all ambient temperature conditions to produce large amounts of vapor. These vapors will be heavier than air, may accumulate and persist in pits, hollows and depressions, and/or travel a considerable distance to a source of ignition and flash back or even explode. Accumulations of vapor or gas in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently and possibly rocket if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 5.1 pounds per gallon at its boiling point temperature.

Propylene does not react with water or many other common materials but contact of very cold liquid propylene with hot water has the potential to result in a liquid “superheat” explosion, which in simple terms, can be attributed to the large temperature differences involved and the extremely rapid and potentially violent manner in which the liquid may vaporize. The product is incompatible with oxidizing materials that may cause its ignition and may react violently or explosively with a wide variety of other chemicals. It is not corrosive to common metals but may affect some plastics, rubber, and coatings. Toxicity of the product is very low by all routes of exposure, but contact with very cold liquid or gas may result in frostbite or freeze burns. Products of combustion may include toxic constituents.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location and weather conditions if propylene is leaking from its container but not on fire. If a bulk container is exposed to direct flame or a fire become uncontrollable, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently and possibly rocket. (Note: The data and information presented below are for relatively pure propylene. The properties of propylene may be altered if it is shipped or stored as a mixture with other substances.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble, most reported values range from 200 to 790 ppm by weight at 68°F (20°C), one source reports 1400 ppm at 70°F (21.1°C)

Solubility in Other Chemicals: Reported soluble in alcohol, acetic acid, and ether; likely to be soluble in many other hydro carbons and their derivatives.

Specific Gravity (Liquid): 0.61 at –52.6°F (–47°C); 0.51-0.52 at 68°F (20°C)

Boiling Point: –53.9°F (–47.7°C) at 1 atm.

Melting Point: –301.4°F (–185.2°C)

Freezing Point: See melting point

Molecular Weight: 42.08

Heat of Combustion: –10,940 cal/g

Vapor Pressure: Approx 10 atm (146.9 psia) at 68°F (20oC)

Flash Point: –162°F (–107.8°C), closed cup

Autoignition Temperature: 851 to 860°F (455 to 460°C), 896 or 927°F (480 or 497°C), reported values vary

Burning Rate: 8 mm/minute

Stability: Stable

Corrosiveness: Not corrosive to common metals; may attack some plastics, rubber, and coatings.

Reactivity with Water: No reaction, but contact of very cold liquid propylene with water may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. If the water is hot, there is a possibility that a liquid “superheat” explosion may occur. Pressures may build to dangerous levels if liquid propylene contacts water in a closed container.

Reactivity with Other Chemicals: May react vigorously, ignite, or explode in contact with strong oxidizing agents or materials. Explosive polymerization is initiated by a lithium nitrate and sulfur dioxide mixture. Reacts violently with oxides of nitrogen and may explode or form an explosive product. Explodes when mixed with trifluoromethylhypofluorite and other hydrocarbons. Variously reported to be incompatible with molten sulfur and certain halogenated compounds, halogens, strong acids and alkalies. May possibly be incompatible with aldehydes and certain elemental metals. Several authorities report propylene may explode spontaneously when heated to high temperatures and subjected to high pressures in confinement.

IDENTIFICATION

Shipping Names: Propylene (USDOT & IMO)

Synonyms and Tradenames: Propene; 1-propene; 1-propylene; methylethylene; methylethene; may be shipped in the U.S. as liquefied petroleum gas (LPG).

Chemical Formula: $CH_3CH = CH_2$

Constituent Components (% each): About 80% or more pure for propylene concentrate or refinery grade; about 92% to 95% pure for chemical grade, about 95k or more pure for technical grade; about 99, or more pure for commercial grade; about 99.75 or more pure for polymer or research grade, reported information varies. Remainder usually consists mostly of propane with smaller amounts of ethane and methane and traces of a wide variety of other substances. According to one manufacturer, experience has shown that propylene may occasionally contain small amounts of radon (a naturally occurring radioactive gas) and its particulate decay products, some of which may be retained in contaminated equipment and pose an inhalation hazard. Gamma radiation may be detected in such cases when propylene is present and for some hours thereafter. (Note: This information was found in only one of numerous data sources. Potential radioactivity was not mentioned elsewhere.)

UN/NA Designation: UN1077 (USDOT & IMO); UN1075 (USDOT)

IMO Designation: 2.1, flammable gas

Physical State As Shipped: Liquid

Physical State As Released: Boiling liquid, gas, or mixture of gas and aerosols (small liquid droplets) depending on release conditions.

Color of the Shipped Material: Colorless, but very cold gas may appear white at first due to condensation of water vapor in the atmosphere.

Odor Characteristics: Practically odorless or like mild petroleum; some shipments may contain a foul (skunk-like) odorant for leakage warning purposes.

Common Uses: Manufacture of a wide variety of other chemicals, resins, gasoline components, raw materials for detergents, polypropylene plastic, and synthetic rubber; used as an aerosol propellant.

PROPYLENE

Class 2.1 (Flammable Gas)

See "UN/NA Designation"
for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 10 to 80 ppm; reported values vary

Unusual Hazards: Extremely volatile and flammable heavier than air gas or vapor that may travel a considerable distance to a source of ignition and flash back. Vapors and gases may persist in pits, hollows, and depressions Unconfined as well as confined vapor clouds may explode if ignited. Small amounts of radioactive gas may be present according to one manufacturer. Propylene may explode spontaneously if subjected to high temperatures and pressures in confinement. Contact of very cold liquid propylene with hot water may result in a liquid “superheat” explosion.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Listed as simple asphyxiant (ACGIH, 1989 90).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of the very high concentrations of propylene gas or vapor that may be present in air at the spill site and some distance downwind. Direct contact should also be avoided. One manufacturer of propylene reports the possibility that small amounts of radioactive radon gas may be present in its product at times.

Hazards of Skin or Eye Contact: Contact with very cold liquid propylene or very cold gas may cause frostbite or freeze burns of the skin or eyes. There is some potential for permanent eye injury. Frostbite may also occur from contact with the surface of a very cold container of the product.

Hazards of Inhalation: High concentrations of propylene gas or vapor in air may cause central nervous system depression. Very high concentrations may cause suffocation by diluting the concentration of oxygen in air below levels necessary to fully support life. Symptoms of central nervous system depression and progressively lower levels of available oxygen are reported to include dizziness, drowsiness, headache, coughing, lachrymation, nausea, fatigue, errors in judgment, excittion, fatigue, rapid pulse, gasping, confusion, giddiness, irregular heartbeat, decrease in blood pressure, vomiting, convulsions, loss of consciousness and death, possibly in seconds and without warning if oxygen levels drop too low. Experiments have shown that propylene causes some degree ot cardiac sensitization in dogs and it is therefore assumed to be a weak cardiac sensitizer in humans.

Hazards of Ingestion: Due to its low boiling point temperature, ingestion of liquid propylene is considered highly unlikely. If it should occur, frostbite of the lips, mouth, and other contacted tissues may be expected.

FIRE HAZARDS

Lower Flammable Limit: Most data sources list 2%,, but values of 1.9% and 2.4% are also reported in the literature.

Upper Flammable Limit: 10.1%-10.3% or 11%-11.1% ; reported values vary.

Behavior in Fire: Liquefied flammable gas. May generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel a a considerable distance to a source of ignition and flash back. Containers may rupture violently in fire and possibly rocket. Propylene is reported to burn with a yellow sooty flame.

Hazardous Combustion Products: Not well-defined; include carbon monoxide, carbon dioxide, and other potentially toxic constituents.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

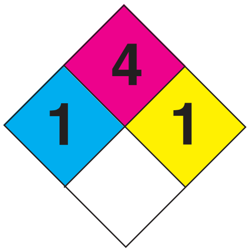
Explosiveness: Containers may rupture violently and possibly rocket in fire. Explosion may result if vapors or gases are ignited in a confined area. There is known potential for explosions involving unconfined vapor clouds. Propylene may explode spontaneously when heated to high temperatures and subjected to high pressures in confinement. Contact with certain other chemicals may result in an explosion. Contact of very cold liquid propylene with hot water may possibly result in the occurrence of a liquid “superheat” explosion.

1077

See "UN/NA Designation"
for other ID numbers.

PROPYLENE

Class 2.1 (Flammable Gas)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of eye contact with very cold liquid or gas and should prevent the skin from becoming frozen from contact with the product or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Dizziness, drowsiness, or other symptoms of central nervous system depression or oxygen deficiency; frostbite or freeze burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. Propylene may be a weak cardiac sensitizer; it may not be prudent to administer epinephrine to the victim.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing after thawing. Wash affected body areas with large amounts of warm water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas.)

First Aid for Ingestion: Wash exposed body areas with warm water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas.)

FIRE RESPONSE

Extinguishing Materials: Stop flow of gas or liquid or let fire burn if discharge is appreciable. Use carbon dioxide or dry chemical on small fires in the open involving smaller containers that can be safely extinguished and isolated from other flammables. Use water spray or foam on large fires to cool surroundings.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Note that contact with water may increase vapor evolution from any pools of liquid propylene that may form on the ground.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the extremely volatile and flammable nature of propylene into account while planning the response. Beware of possible heavy gas accumulations in low areas.

PROPYLENE
Class 2.1 (Flammable Gas)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Propylene discharges may expose downwind areas to flammable concentrations over considerable distances in some cases, particularly if the discharge is large. Distances associated with toxic levels are likely to be less for this particular material.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to propylene vapors or fumes in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Contact of liquid propylene pools with water spray or fog may increase vapor evolution.

MITIGATION

Apply water at a point downwind and do not allow it to contact pools of liquid propylene.

TECHNIQUE

FOAM . . . There is a possibility that application of firefighting foam to the surface of liquid propylene pools may slow the release of vapors into the atmosphere after an initial increase.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed or vaporized. Contain increased volume if necessary. Proceed with caution if the initial increase in vapor evolution may affect downwind populations or operational safety.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid propylene may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Very high pressures may develop in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as nitrogen or carbon dioxide to precool transfer lines and receiving containers to avoid high initial vaporization rates upon entry of product into the equip ment.

WATER SPILL

Liquid propylene will boil or rapidly vaporize from the water surface with negligible dissolution in the vast majority of cases.

October 1993

PROPYLENE DICHLORIDE
Class 3 (FLAMMABLE LIQUID)

GENERAL INFORMATION

Propylene dichloride is a colorless flammable liquid with an odor variably described as sweet, pleasant or unpleasant, and resembling chloroform. It is slightly soluble in water and heavier, so may be expected to sink in water and dissolve at a very slow rate. It may be easily ignited under moderate to high ambient temperature conditions. Vapors of propylene dichloride may be heavier than air, may persist for a time in low areas, and/or may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. The liquid weighs about 9.6 pounds per gallon.

It does not react with water and is stable in normal transportation. Although it is not expected to be generally corrosive to metals, it can react with aluminum and possibly other active metals, and may attack various forms of plastics, rubber, and coatings. It is otherwise reactive with strong acids, strong oxidizers and possibly a variety of other chemical substances. Toxicity of the substance is generally low to moderate by direct contact and ingestion but quite high via inhalation. Products of combustion are reported to include toxic carbon monoxide and carbon dioxide, hydrogen chloride (and hydrochloric acid), small amounts of chlorine, and phosgene, and possibly other harmful substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning if propylene dichloride is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently and possibly rocket.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very slightly soluble; approx 0.25 - 0.27 g/100 g water (2500 - 2700 ppm) at 68°F (20°C).

Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, ether, and many other common solvents.

Specific Gravity (Liquid): 1.1560 -1.1593 at 68°F (20°C).

Boiling Point: 205.0 - 206.2°F (96.1 - 96.8°C) at 1 atm.

Melting Point: -148.7°F (-100.4°C); other to -94°F (- 70°C).

Freezing Point: See melting point.

Molecular Weight: 112.99.

Heat of Combustion: -4,100 cal/g.

Vapor Pressure: Approx 10 mm Hg (0.1933 psia) at 21°F (-6.1°C); and 100 mm Hg (1.933 psia) at 102.9°F (39.4°C).

Flash Point: 60°F (15.6°C), closed-cup; 70°F (21.1°C), open-cup.

Autoignition Temperature: 1,035°F (557°C).

Burning Rate: 3.2 mm/minute.

Stability: Stable.

Corrosiveness: Limited data available. Not expected to be corrosive to metals but may react with aluminum and other active metals under appropriate conditions. May attack some forms of plastics, rubber, and coatings.

Reactivity with Water: No reaction.

Reactivity with Other Chemicals: Containment in unvented aluminum equipment may possibly result in an explosion after some period of time, especially but not necessarily if any aluminum chloride is or becomes present. May behave similarly with other active metals such as zinc, with metallic powders being more reactive than solid sheets. Contact with strong acids may result in product decomposition. Reactions of halogenated organic materials such as propylene dichloride with cyanides, mercaptans or other organic sulfides typically generate heat, while those with mineral acids, amines, azo compounds, hydrazines, caustics or nitrides commonly evolve heat and toxic or flammable gases. Reactions with oxidizing mineral acids may generate heat, toxic gases and fires. Those with alkali or alkaline earth metals, certain other chemically active elemental metals like aluminum, zinc or magnesium, organic peroxides or hydroperoxides, strong oxidizing agents, or strong reducing agents typically result in heat generation and explosions and/or fires.

IDENTIFICATION

Shipping Names: Propylene dichloride.

Synonyms and Tradenames: Dichloropropane; alpha, beta-dichloropropane; alpha, beta-propylene dichloride; 1,2-DCP; 1,2-dichloropropane; PDC; and propylene chloride.

Chemical Formula: $CH_3CHCICH_2C1$.

Constituent Components (% each): 99% or more pure but very crude grades are also marketed.

UN/NA Designation: UN1279.

IMO Designation: 3, flammable.

Physical State As Shipped: Liquid.

Physical State As Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Sweet, pleasant; unpleasant; like chloroform.

Common Uses: Solvent for fats, oils, waxes, gums, resins, and other substances; used in dry cleaning fluids, metal degreasing agents, and fumigant mixtures, intermediate in production of perchloroethylene and carbon tetrachloride.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

PROPYLENE DICHLORIDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Thresholds of 50 to 90 ppm have been reported.

Unusual Hazards: Reacts in an unusual manner with aluminum and possibly other active metals. Both the liquid and vapor, upon contact with a hot surface or naked flame, decompose to form extremely toxic phosgene gas and other harmful substances.

Short Term Exposure Limit (STEL): 110 ppm for 15 minutes (ACGIH, 1992 - 93; OSHA, 1989).

Time Weighted Average (TWA) Limit: 75 ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989).

Conditions to Avoid: Heat, fire, sparks, and contact with hot surfaces; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high concentrations of propylene dichloride vapors that may be present in air at the spill site and over considerable downwind distances. Direct contact and ingestion should also be avoided. This substance is suspected of being a carcinogen and mutagen.

Hazards of Skin or Eye Contact: Vapors of propylene dichloride are known to temporarily irritate the eyes of humans and cause lacrimation when exposures are of limited duration. Contact of the eyes with liquid propylene dichloride or its mists may cause smarting that may persist for several hours and damage to the cornea that is most likely to be superficial and temporary in nature. Prolonged or repeated skin contact with the liquid may cause drying and cracking (and possibly a rash) due to the defatting action of the product. More severe irritation and inflammation may occur if the liquid is confined against the skin such as by clothing. The skin of some susceptible people, may become sensitized to propylene dichloride upon repeated or prolonged exposure such that they become allergic. Liquid propylene dichloride can be absorbed through intact skin but at such a slow rate that a single exposure, unless massive and prolonged, is not likely to result in significant intoxication. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Vapors of propylene dichloride are irritating to the nose, throat, and respiratory system. Exposure to high concentrations in air may cause central nervous system depression, narcosis, and other effects with symptoms that may variably include headache, coughing, sneezing, changes in vision and speech, nausea, personality change (such as agitation or drunkenness), drowsiness, lightheadedness, dizziness, incoordination, irritation of the lungs, tremors, spasms, seizures, bronchitis, pneumonia, unconsciousness, and possibly death in severe cases. High concentrations are rapidly anesthetic but certain other effects may be delayed in onset. Prolonged overexposure may also result in anemia, fatty degeneration and biological oxidation of the liver and kidneys (and occasionally heart), possible effects on the brain (which may be permanent), effects on the adrenal glands and spleen, increased risk of serious heart rhythm changes, and "disseminated intravascular coagulation". Any alcohol consumed before or after exposure may greatly increase the severity of effects, particularly upon the liver and/or kidneys. 50% of rats died after exposure to 2000 to 3000 ppm for 8 hours. The NIOSH IDLH (1990) for propylene dichloride is 2000 ppm. The saturated vapor concentration directly over a pool of propylene dichloride is about 13,160 ppm at 21°F (- 6.1°C); 51,710 to 56,580 ppm at 68°F (20°C); and 131,580 ppm at 102.9°F (39.4°C).

Hazards of Ingestion: Ingestion of liquid propylene dichloride causes many of the same effects as excessive inhalation but the single dose oral toxicity of the substance is not high. The dosages reported to cause the death of 50% of rats and mice in laboratory experiments are respectively 1.9 - 2.2 and 0.86 grams per kilogram of an animal's body weight. Some differences in effects are that ingestion may cause vomiting, and that if any liquid is aspirated into the lungs, it may be rapidly absorbed and result in injury to other body systems. Abdominal pain, widespread small hemorrhages in the skin or mucous membranes, blood in the urine, uterine bleeding, congestion of the lungs and bladder, and hemorrhages in the stomach and respiratory tract are some of many additional effects of excessive ingestion. As in the case of inhalation, there is a possibility that consumption of alcohol before or after an exposure may greatly increase risks to the liver and/or kidneys.

FIRE HAZARDS

Lower Flammable Limit: Nominally 3.4%; 3.2% at 122°F (50°C).

Upper Flammable Limit: Nominally 14.5%; 12.2% at 122°F (50°C).

Behavior in Fire: Flammable liquid. May possibly generate large amounts of flammable vapors upon release. Such vapors may travel some distance to a source of ignition and flash back. There is some potential for containers to rupture violently and possibly rocket in fires. Both the liquid and vapor, on contact with a hot surface or a naked flame, decompose to form phosgene, an toxic gas, and other harmful substances.

Hazardous Combustion Products: Reported to include toxic carbon monoxide and carbon dioxide, corrosive hydrogen chloride (and hydrochloric acid), small amounts of chlorine, small amounts of toxic phosgene, and possibly other harmful substances.

1279

PROPYLENE DICHLORIDE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS *(CONTINUED)*

EXPLOSION HAZARDS

Explosiveness: Explosion may result if vapors from propylene chloride at or above its flash point are ignited in a confined area. There is some potential for containers to rupture violently and possibly rocket in fires. Contact with certain metals or chemicals may result in an explosion.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with products of combustion in fires involving propylene dichloride. Compatible materials for propylene dichloride itself may include polyvinyl alcohol, Teflon, Viton, and butyl rubber (less resistant than others listed). Materials that may be compatible for both hydrochloric acid and chlorine (products of combustion) include butyl rubber, neoprene, nitrite rubber, and Saranex. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of eyes, nose, throat, respiratory system, or skin; headache, coughing, nausea, vomiting, drowsiness, dizziness, tremors, abdominal pain, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. See note below on consumption of alcohol and administration of sympathomimetic drugs.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately in the case of eye contact and promptly in the case of skin contact, particularly if irritation persists after washing.

First Aid for Ingestion: Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Because rapid absorption may occur through the lungs if propylene dichloride is aspirated, the decision of whether or not to induce vomiting should be made by a physician since the danger of aspiration must be weighed against toxicity when considering emptying the stomach. If lavage is performed, endotracheal and/or esophageal control is suggested.) Be advised that exposures may increase myocardial irritability. Do not administer sympathomimetic drugs such as epinephrine (i.e., adrenalin) unless absolutely necessary. Note that alcohol consumed before or after exposure may increase toxicity and that excessive exposures may aggravate preexisting liver and kidney disease. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective. Some authorities recommend use of alcohol foam instead of regular foam; both may be effective to some degree.

Extinguishing Techniques: Corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full protective clothing if contact with dense fumes/smoke is anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent

PROPYLENE DICHLORIDE
Class 3 (Flammable Liquid)

SPILL RESPONSES *(CONTINUED)*

substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines prior to use. Take the volatility, flammability, toxicity, and reactivity of propylene dichloride into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Propylene dichloride discharges may expose downwind areas to toxic and possibly flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to propylene dichloride vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of propylene dichloride from contact with its airborne vapors.

MITIGATION

Where deemed necessary, contain contaminated water and remove it as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam (either regular or alcohol type) applied to the surface of liquid pools may slow the release of propylene dichloride vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . Propylene dichloride is heavier than water and only very slightly soluble. Gentle application of a light spray of water onto the surface of confined pools of the liquid may form a floating layer (i.e., blanket) of water that reduces vapor emissions.

CONSEQUENCE

Addition of water will increase the volume of contained liquids.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid propylene dichloride may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

PROPYLENE DICHLORIDE
Class 3 (Flammable Liquid)

LAND RESPONSES *(CONTINUED)*

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION. . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable vapors present in the area may be ignited by motorized equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Propylene dichloride is somewhat heavier than water and only very slightly soluble.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic or flammable vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

CHEMICAL TREATMENT . . . Application of appropriate chemical agent(s) to the contaminated body of water and subsequent mixing may in some cases reduce environmental hazards.

CONSEQUENCE

Some agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe treatment techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION. . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1997

PROPYLENE TETRAMER

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Propylene tetramer is a clear and colorless liquid with a hydrocarbon odor used in surfactant manufacturing. Purity of the product is nearly 100% with only .01% of an antioxidant reported as a constituent component. This material is generally stable but contact with strong oxidizers should be avoided.

The primary route of entry is inhalation, although contact can occur through skin, eye or ingestion. Severe irritation to associated organs can occur for all possible routes of entry. Prolonged exposure to the skin can cause defatting. Inhalation can lead to CNS affects or death and ingestion creates an aspiration hazard.

It is classified as a flammable liquid by US DOT and IMO, however if it is transported in bulk it can be classified as a combustible liquid. When heated to decomposition, product gives off carbon monoxide, carbon dioxide and other various hydrocarbons. It has a relatively high boiling point, low evaporation rate and vapor pressure at normal ambient temperatures and therefore, it is not expected to generate much flammable vapors beyond the immediate spill area. Under some conditions vapors are heavier than air and can travel to sources of ignition creating a flash back. Runoff from fire control or dilution water may be toxic and/or flammable and cause environmental damage.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble
Solubility in Other Chemicals: Soluble in hydrocarbon solvents, ethanol, acetone and ethane, slightly soluble in water.
Specific Gravity (Water=1): .771-.776 at 15.6°C (60.1°F)
Vapor Density (Air=1): 5.81
Boiling Point: 180-202.8°C (356-397°F)
Melting Point: -100°C (-148°F)
Freezing Point: See melting point
Molecular Weight: 168.36
Heat of Combustion: Unavailable
Evaporation Rate (n-Bu Acetate=1): Less than 0.1
Vapor Pressure: 52 mm Hg at 37.8°C (100°F)
Flash Point: 23-61°C (73.4-141.8°F); >54.4°C (130°F) also reported
Autoignition Temperature: 243°C (469°F)
Burning Rate: Unavailable
Flammable Limits: 0.2% (LEL) - 12.7% (UEL)
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Avoid contact with strong oxidizing agents.

IDENTIFICATION

Shipping Name(s): Propylene tetramer (USDOT & IMO)
Synonyms and Tradenames: Amsco tetramer; Dodecene; Dodecylene; Propene tetramer; Tetrapropylene
CAS Registry No: 68526-58-9
Chemical Formula: $C_{12}H_{24}$
Constituent Components (% each): Hydrocarbon (100%); sometimes reported to have .01% antioxidant.
UN/NA Designation: UN2850
IMO Designation: 3.3
RTECS Number: UD1860000
NFPA 704 Hazard Rating: 1 (Health): 2 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear and colorless.
Odor Characteristics: Hydrocarbon odor.
Reportable Quantity: See appendix I
Common Uses: Surfactant manufacturing.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PROPYLENE TETRAMER

Class 3 (Flammable Liquid) or Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Exposure can cause severe irritation to the eyes, skin and respiratory tract. Defatting can occur as well as central nervous system effects and aspiration.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 100ppm recommended by one manufacturer.

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as strong oxidizing agents.

HEALTH HAZARDS

Potential Health Hazards: Contact with skin or eyes can cause irritation or defatting (in the case of skin). Aspiration hazard exists if ingested. Inhalation can cause irritation to the respiratory tract as well as other symptoms.

Hazards of Skin or Eye Contact: Contact with eyes can cause severe irritation, redness, tearing and blurred vision. Prolonged or repeated contact with skin can cause moderate irritation, defatting and dermatitis.

Hazards of Inhalation: Excessive inhalation of vapors can cause nasal and respiratory irritation, central nervous system effects including dizziness, weakness, fatigue, nausea, headache and possible unconsciousness including death.

Hazards of Ingestion: Ingestion can cause gastrointestinal irritation, nausea, vomiting and diarrhea. Aspiration of material into the lungs can cause chemical pneumonitis which can be fatal.

FIRE HAZARDS

Lower Flammable Limit: 0.2%

Upper Flammable Limit: 12.7%

Behavior in Fire: Propylene tetramer is a flammable liquid with a fire potential. It will readily ignite and burn if exposed to sources of ignition, heat and flame. It has a relatively low vapor pressure at ambient temperatures, but if heated it can produce sufficient vapors which are heavier than air, can travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may be invisible and may travel to ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources and flash back. Runoff from fire control or dilution water may be flammable and/or toxic and cause environmental damage.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, and various hydrocarbons.

EXPLOSION HAZARDS

Explosive Potential: Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas where vapors can accumulate, since it may present a vapor explosion hazard. Containers exposed to prolonged heat and flame may violently rupture.

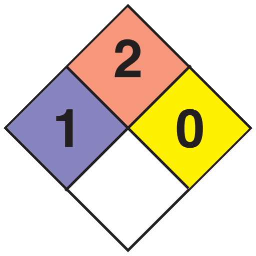
PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing

2850

PROPYLENE TETRAMER

Class 3 (Flammable Liquid) or
Combustible Liquid



(EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

FIRST AID

Nonspecific Symptoms: Primary route of entry is from inhalation.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact, wash with soap and copious amounts of water. Remove contaminated clothing. Treatment should be directed towards the control of symptoms and the clinical condition. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, do not give liquids or induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, foam or water spray (fog).

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Do not extinguish fire unless source of leak can be shut off without risk to personnel. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Containers should be cooled with water spray from a distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Propylene tetramer is a flammable liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition.

PROPYLENE TETRAMER

Class 3 (Flammable Liquid) or Combustible Liquid

Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Due to its high boiling point and low vapor pressure at ambient temperatures, propylene tetramer is not expected to release much vapor beyond the immediate spill area. However, continuous air monitoring of the immediate area and downwind should be conducted for the presence and/or spread of any hazardous concentrations of flammable and/or toxic vapors especially if the material is involved in a fire or a large spill is involved. The evacuation zone should be expanded as conditions warrant.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind if there is a large spill or the material is involved in a fire.

MITIGATION

Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used effectively to control the production of vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated runoff and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas runoff may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

PROPYLENE TETRAMER
Class 3 (Flammable Liquid) or Combustible Liquid

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor the situation for the presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

PROPYLENE TETRAMER

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

CONTAINMENT DIKES . . . If released into water sources, propylene tetramer is expected to float on the surface. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION . . . Material is not water soluble and lighter than water. Overflow dams may be used to confine or divert the spill to a limited area.

CONSEQUENCE

Some material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of any vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Booms may be an effective means to recover spilled material since the material is not water soluble and will float on the surface of the water. Barriers of suitable material may be used to confine the spill to a limited area to prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Continually monitor the integrity of the boom/barriers.

TECHNIQUE

SURFACE SKIMMING . . . Surface skimming may be effective since the material is not water soluble and is lighter than water.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Continually monitor the integrity of the boom/barriers.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat or commercial sorbent materials compatible with propylene tetramer may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Continually monitor for flammable vapors and eliminate ignition sources.

January 1990

PROPYLENEIMINE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Propyleneimine is a colorless, fuming, flammable liquid that is fully soluble in water and will mix freely. It has an odor resembling ammonia and is used as an organic intermediate in making various products for the paper, textile, rubber, agricultural, petroleum, and pharmaceutical industries. Its flash point of 25°F indicates it may be easily ignited under most ambient temperature conditions. Vapors may be heavier than air and may in any case travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 6.7 pounds per gallon.

Propyleneimine reacts with water in a slow and nonhazardous fashion to form propanolamine or methylethanolamine according to various authorities. It is stable in normal transportation when kept in contact with anhydrous caustic soda (sodium hydroxide). Exposure to excessive heat or acids may initiate a violent or explosive polymerization, as may contamination with certain other substances, when propyleneimine is not diluted with water. Besides being incompatible with oxidizing agents and silver, the product is likely to be reactive with a wide variety of other chemical substances. Toxicity of the product is very high by all routes of exposure and it must be realized that the volatility of the product indicates that high concentrations of propyleneimine vapors may be present in air. Products of combustion include toxic oxides of nitrogen, carbon monoxide, carbon dioxide, and possibly other toxic constituents.

If propyleneimine is leaking (not on fire), downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of at least one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Soluble in many organic solvents

Specific Gravity (Liquid): 0.801 - 0.807 at 68°F (20°C)

Boiling Point: 150.8 - 155°F (66 - 68.3°C) at 1 atm.

Melting Point: - 85°F (- 65°C)

Freezing Point: See melting point

Molecular Weight: 57.1

Heat of Combustion: - 8600 cal/g

Vapor Pressure: 112 mm Hg (2.165 psia) at 68°F (20°C)

Flash Point: 25°F (- 3.9°C); closed or open cup; reports vary

Autoignition Temperature: Unavailable

Burning Rate: *4.1* mm/minute

Stability: Stable in normal transportation when kept in contact with anhydrous caustic soda (sodium hydroxide) which acts as both a dehydrating agent for moisture and neutralization agent in case there is accidental exposure to an acid. May polymerize violently upon excessive heating or if contaminated by acids, acid fumes, or possibly other chemicals.

Corrosiveness: Carbon and stainless steels are preferred materials of construction; silver or silver solder should never be used since silver has been reported to react violently with imines. May attack some forms of plastics, rubber, and coatings. For ethyleneimine, a close relative, storage or handling in tin, lead, low carbon steel, polyethylene, Kel-F, or teflon is recommended; any and all contact with silver or aluminum is restricted.

Reactivity with Water: Reacts slowly and in nonhazardous fashion to form propanolamine or methylethanolamine (reported information varies).

Reactivity with Other Chemicals: Undiluted product may polymerize violently or explosively in contact with acids (including carbonic acid which is C02 gas in water), acid-forming materials, and a variety of other catalysts. Incompatible with oxidizing agents. Similar products are reactive with a wide variety of chemical substances. For ethyleneimine, a close relative, it is reported that carbon dioxide, oxidizers, silver, aluminum, other catalytically active metals, or chloride ions may initiate polymerization; that the product forms explosive compounds with silver (including silver solder), chlorine, or sodium hypochlorite; and that it is also reactive with acrolein, allyl chloride, carbon disulfide, epichlorohydrin, glyoxal, vinyl acetate, oxidizing agents, betapropiolactone, and other materials.

IDENTIFICATION

Shipping Names: Propyleneimine, inhibited (USDOT); propyleneimine (IMO)

Synonyms and Tradenames: 1,2-propyleneimine; propylenimine; 1,2-propylenimine; propylene imine; 2-methylaziridine; methylethyleneimine; 2-methylethyleneimine; 2-methylazacyclopropane

Chemical Formula: CH_3CHCH_2NH (ring structure)

Constituent Components (% each): Contains pellets or lumps of anhydrous caustic soda (sodium hydroxide) to inhibit polymerization.

49 STCC: 49 070 *40*

UN/NA Designation: UN1921

IMO Designation: 3.2, flammable liquid

Physical State As Shipped: Liqiud

Physical State As Released: Liquid

Color of the Shipped Material: Colorless, fuming

Odor Characteristics: Like ammonia

Common Uses: Organic intermediate used to make numerous products for the paper, textile, rubber, and pharmaceutical industries. Also used in producing petroleum products and agricultural chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

PROPYLENEIMINE
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Toxic, flammable, reactive, and relatively volatile fuming liquid. May polymerize violently or explosively if exposed to excessive heat or contaminated by acids or various other materials. Vapors are not inhibited and may form polymers in vents or flame arresters resulting in stoppage.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 2 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with acids or other incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Propyleneimine is a highly toxic substance that attacks the body in many ways, is a suspected human carcinogen in long term occupational exposures, and may also have mutagenic effects under such conditions. All exposures to this substance should be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid propyleneimine may result in slow healing burns. The product can be absorbed through the skin rapidly in toxic amounts causing various effects of inhalation, and possibly has the potential to cause sensitization of the skin on occasion. Some effects of exposure may be delayed. Contact with the eyes may cause burns, permanent eye damage, and possibly even death. Do not wear contact lenses when working with propyleneimine.

Hazards of Inhalation: Vapors of propyleneimine are irritating to the eyes, mucous membranes, nose, throat, and upper respiratory tract. By analogy to the effects of ethyleneimine, effects on the eyes may be expected to increase over several hours after exposure but are usually temporary and involve reddening of the whites of the eyes. Similarly, excessive inhalation may be expected to cause sore throat, swelling of the face, persistent coughing, nausea, vomiting, headache, dizziness, difficult breathing, laryngeal edema, effects on the blood, kidney damage, bronchitis, pulmonary edema, hemorrhage, bronchial pneumonia, convulsions, and possibly death. Several effects may be delayed in onset. Exposure to 500 ppm in air for one hour was lethal to some guinea pigs in laboratory experiments; exposure for four hours to 500 ppm proved lethal to some rats.

Hazards of Ingestion: Propyleneimine is highly toxic via ingestion. Effects may include burns of the mouth and throat, and (by analogy to the effects of ethyleneimine) scarring of the esophagus, kidney and liver injury, damage to the rods and cones of the retina leading to blindness, effects associated with inhalation, and possibly death.

FIRE HAZARDS

Lower Flammable Limit (LFL): Unavailable

Upper Flammable Limit (UFL): Unavailable

Behavior in Fire: Flammable liquid. May generate large quantities of flammable and highly toxic vapors upon release. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in explosive polymerization.

Hazardous Combustion Products: Not well-defined; may include toxic oxides of nitrogen, carbon monoxide, carbon dioxide, and other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit (LEL): Unavailable

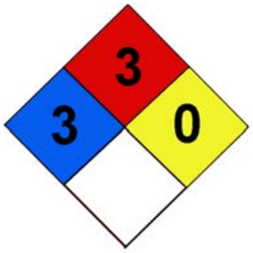
Upper Explosive Limit (UEL): Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat may cause spontaneous violent polymerization resulting in explosion. Explosive polymerization may also occur in presence of acids, acid-forming materials, and possibly other substances. Contact with certain other chemicals may result in formation of explosive mixtures.

1921

PROPYLENEIMINE

Class 3 (Flammable Liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas-tight safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; coughing, headache, dizziness, nausea, and other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or skin irritation persists after washing.

First Aid for Ingestion: *If* victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately. (Note: Although the above suggestion to induce vomiting after the ingestion of large quantities of water comes from NIOSH, other authorities recommend that vomiting not be induced, presumably to avoid the possibility of aspiration into the lungs and the attendant possibility of pulmonary edema and bronchial pneumonia. If possible, seek immediate medical advice on this issue before treatment, realizing that both courses of action expose the victim to different but serious risks.)

FIRE RESPONSE

Extinguishing Materials: Water spray or fog, dry chemical, Halon, alcohol foam. Water may be ineffective but may be used to dilute the spill to a nonflammable mixture. Note that carbon dioxide should be used with care where there is a possibility that it may form carbonic acid, since carbonic acid may initiate violent or explosive polymerization of the propyleneimine.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof tools and explosion-proof equipment where necessary. Take the volatile, flammable, reactive, and highly toxic nature of propyleneimine into account when planning the response. Exclude air from containers of propyleneimine if possible to prevent entry of carbon dioxide and possible formation of carbonic acid. Keep liquid propyleneimine in contact with solid caustic soda (sodium hydroxide) to inhibit polymerization.

PROPYLENEIMINE
Class 3 (Flammable Liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Propyleneimine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to propyleneimine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of propyleneimine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid propyleneimine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of propyleneimine vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for firefighting suggests it may have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of the foam may be short-term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES.. . Propyleneimine may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained propyleneimine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

PROPYLENEIMINE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under the guidance of a qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable gases or vapors present in air in the spill area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Propyleneimine is fully soluble in water and will mix freely to form an alkaline solution.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

PROPYLENEIMINE
Class 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to contaminated water that is alkaline, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. Cationic exchangers may be used for neutral or acidic solutions. (Note: The above recommendations by various authorities were found for spills of ethyleneimine into water. Although similar recommendations were not found for propyleneimine, there is a good chance that these remedial measures may also be appropriate for the latter product. Consult qualified experts for guidance.)

CONSEQUENCE

Recovery of adsorbents may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2003

PROPYLENE OXIDE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Propylene oxide is a highly volatile colorless liquid with the relatively low boiling point of 93.7°F. It has a sweet alcoholic and ethereal odor and is used for making propylene glycol, ingredients of polyurethane foam, detergents, brake fluids, fumigants, and synthetic lubricants. It is moderately soluble in water and will quickly dissolve. Its flash point of - 35°F indicates that the product may be easily ignited under all ambient temperature conditions. Its low boiling point suggests that the product will boil at high ambient temperatures or otherwise rapidly evaporate when spilled, thus evolving large amounts of vapor. These vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, or depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 6.9 pounds per gallon.

Propylene oxide does not react with water or many other common materials and is stable in normal transportation. Excessive heat or contamination by various chemicals may result in self-polymerization and possible violent rupture of its container. The product is otherwise reactive with a variety of chemicals. It is not considered to be highly corrosive, but no acetylide-forming metals like copper and its alloys should be allowed to contact propylene oxide. The product is a potential carcinogen and may be present in air in high concentrations. Products of combustion may include toxic constituents.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if propylene oxide is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 40.5 g/100g water at 68°F (20°C).
Solubility in Other Chemicals: Soluble in alcohol and ether
Specific Gravity (Liquid): 0.83 at 68°F (20°C)
Vapor Density: 2.0
Boiling Point: 93.7°F (34.3°C) at 1 atm
Melting Point: See freezing point.
Freezing Point: - 169.4°F (- 111.9°C)
Molecular Weight: 58.08
Heat of Combustion: - 7221 cal/g
Evaporation Rate (butyl acetate=1): >1
Vapor Pressure: 442 mm Hg (8.54 psia) at 68°F (20°C)
Flash Point: - 35°F (- 37.2°C), closed cup
Autoignition Temperature: 840 - 869°F (449 - 465°C)
Burning Rate: 3.3 mm/minute
Flammable Limits: 2.1% (LFL) - 38% (UFL)
Stability: Stable, but may polymerize under appropriate conditions.
Polymerization Potential: Polymerization may occur due to high temperatures or contamination with alkalis, aqueous acids, amines or acidic alcohols.
pH: 7
Corrosiveness: May attack some plastics, rubber, and coatings. Avoid acetylide-forming metals such as copper and its alloys.
Reactivity with Water: No reaction.
Reactivity and Incompatibility: Alkalis, acids, amines, acidic alcohols, peroxides, and anhydrous metal chlorides like iron or aluminum chloride may initiate polymerization. Also reacts with oxidizing materials, various oxides and chlorides, alkali metal hydroxides, chlorine, ammonia and acetylide forming metals.

IDENTIFICATION

Shipping Name(s): Propylene oxide (USDOT & IMO)
Synonyms and Tradenames: 1,2-Epoxypropane; Methylethylene oxide; Methyl oxirane; Propene oxide; Epoxy propane; 1,2-Propylene oxide.
CAS Registry No.: 75-56-9
Chemical Formula: CH_3CHOCH_2
Constituent Components (% each): 99.99 - 100% pure
UN/NA Designation: UN1280
IMO Designation: 3, Flammable liquids
RTECS Number: TZ2975000
NFPA 704 Hazard Rating: 3 (Health): 4 (Flammability): 2 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid (boils at 93.7°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, pungent, like alcohol or ether
Reportable Quantity: See appendix I
Common Uses: Mfg. propylene glycol, other glycols, ingredients of polyurethane foam, detergents, brake fluids, fumigants, synthetic lubricants, stabilizer for methylene chloride, treating wood for termite resistance, pH control agent and for dried fruits and food stuffs. Often used as an intermediate in the synthesis of other chemicals and polymers.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

PROPYLENE OXIDE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 9.9 - 200 ppm; reported values vary

Unusual Hazards: Highly volatile flammable liquid with heavier than air vapors that may travel considerable distance to a source of ignition. May polymerize and violently rupture container if exposed to heat or various chemical contaminants (see Reactivity With Other Chemicals section). Vapors may persist for a time in pits, hollows and depressions.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 20 ppm over each 8 hours of a 40 hour work week. (ACGIH)

IDLH: 400 ppm

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air, but direct contact and ingestion should also be strictly avoided. Material is a potential carcinogen.

Hazards of Skin or Eye Contact: Contact of liquid propylene oxide with the skin may cause irritation, blistering and burns upon short exposure, especially when the product is confined to the skin by contaminated jewelry or clothing. Contact with the eyes may cause corneal burns.

Hazards of Inhalation: Vapors of propylene oxide may cause irritation of the eyes, nose, throat and lungs. High concentrations in air may cause central nervous system depression with symptoms including loss of coordination, headache, nausea, vomiting, weakness, difficult breathing, unconsciousness and possibly death. Exposure of dogs to 2030 ppm in air for 4 hours caused some deaths in laboratory experiments.

Hazards of Ingestion: Ingestion may result in irritation and burns of the mouth and gastrointestinal tract and various symptoms of inhalation.

FIRE HAZARDS

Lower Flammable Limit: 2.1%

Upper Flammable Limit: 38%

Behavior in Fire: Containers may rupture violently in fire due to over pressurization. May generate large quantities of corrosive vapors and fumes upon release. Contact with organic matter may cause ignition.

Hazardous Combustion Products: Thermal decomposition may produce toxic fumes of phosphorous oxides and/or phosphine, carbon monoxide and carbon dioxide. Also see decomposition products of water reaction.

EXPLOSION HAZARDS

Explosive Potential: Very reactive. Containers may rupture violently in fire. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Explosive hydrogen gas evolved in reactions with some metals and may explode if ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

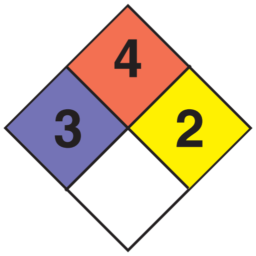
Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact and any possibility of skin contact with the spilled product. This may include rubber boots, gloves, face shields, splash- proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include polyethylene. Tychem® 9400, Tychem® BR, Tychem® 10,000 and Tychem® TK are reported to have greater than 480 minute normalized breakthrough times.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

1280

PROPYLENE OXIDE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, nose, throat or lungs; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if skin irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Get medical attention.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, alcohol-resistant foam or water spray. Water may be ineffective but may be used to dilute spills to non-flammable mixtures.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Propylene oxide may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Propylene oxide is a highly flammable and corrosive liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Propylene oxide may float on top of water. Do not use combustible materials, such as sawdust. According to one source, clay should not be used as it reported to react with propylene oxide.

PROPYLENE OXIDE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of material from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam applied to the surface of liquid pools may slow the release of propylene oxide vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

DILUTION . . . The addition of a large amount of water to propylene oxide may slow the release of vapors into the atmosphere. Use this technique only for small spills and only on the advisement of product experts.

CONSEQUENCE

Vapor or fume evolution may be increased during and immediately after water application, thus increasing downwind and local hazards for a time. Addition of water will increase the volume of material requiring recovery.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Propylene oxide may be confined by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Confined material may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

PROPYLENE OXIDE
Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth, or other absorbent non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

PROPYLENE OXIDE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

PYRIDINE
Class 3 (Flammable liquid)

GENERAL INFORMATION

Pyridine is a colorless or slightly yellow flammable liquid that has a sharp, unpleasant, nauseating, burnt odor and that is used as a solvent, as a denaturant, and in the making of paints, explosives, dyestuffs, rubber, and other products. It is fully soluble in water and will mix freely. Its flash point of 66 - 68°F indicates that is can be easily ignited under a wide range of ambient temperature conditions. Vapors of pyridine may travel some distance to a source of ignition and flash back at warmer temperatures. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 8.2 pounds per gallon.

Pyridine does not react with water, is considered stable in normal transportation, and is generally non-corrosive (although copper and its alloys, including brass, are not considered compatible and the product may cause some forms of plastics and rubber to deteriorate). Contact with strong oxidizing agents may cause fires or explosions directly or produce potentially explosive substances, and pyridine is otherwise reactive with a variety of substances. Toxicity of pyridine is generally low to moderate with the exception of exposures resulting in direct contact of the liquid with the eyes. Products of thermal decomposition include toxic cyanide fumes while those of combustion include toxic oxides of nitrogen and carbon monoxide.

If pyridine is leaking but not on fire, downwind evacuation should be considered until properly equipped responders have evaluated the hazard. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in alcohol, ligroin, ether, petroleum ether, oils, and many other organic liquids.
Specific Gravity (Liquid): 0.982 - 0.983 at 68°F (20°C)
Boiling Point: 239 - 240°F (115 - 115.5°C) at 1 arm.
Melting Point: - 43.6 to - 42.9°F (- 42 to - 41.6°C)
Freezing Point: See melting point
Molecular Weight: 79.10
Heat of Combustion: - 7992 to - 8142 cal/g
Vapor Pressure: 14 - 18 mm Hg (0.271 - 0.348 psia) at 68°F (20°C)
Flash Point: 66 - 68°F (18.9 - 20°C), closed cup
Autoignition Temperature: 900°F (482°C)
Burning Rate: 4.3 mm/minute
Stability: Stable
Corrosiveness: Non-corrosive in general but copper and its alloys are not considered compatible. Contact may cause some forms of plastics and rubbers to deteriorate.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with oxidizing materials, maleic anhydride, possibly other acid anhydrides, strong acids, formamide, sulfur trioxide, iodine, beta-propiolactone, chromium trioxide, and possibly other substances.

IDENTIFICATION

Shipping Names: Pyridine (USDOT and IMO)
Synonyms and Tradenames: Azabenzene; azine
Chemical Formula: C_55H_55N or $CH[(CHCH)_2]N$
Constituent Components (% each): Often 99% or more pure, but cruder grades may also be shipped.
49 STCC: 49 092 77
UN/NA Designation: UN1282
IMO Designation: 3.2, flammable liquid
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless or slightly yellow liquid
Odor Characteristics: Sharp, penetrating; strong, unpleasant; burnt, pungent; nauseating. Olfactory fatigue may occur quickly.
Common Uses: Mfg. of paints, explosives, dyestuffs, rubber, vitamins, sulfa drugs, fungicides, disinfectants, and water proofing agents; solvent in chemical industry; denaturant for ethyl alcohol and antifreeze mixtures.

PYRIDINE
Class 3 (Flammable liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odo: Concentration: Less than 1 ppm; odor fatigue may occur rapidly.

Unusual Hazards: Flammable liquid of significant but not high volatility. Thermal decomposition may produce cyanide fumes.

Short Term Exposure Limits (STEL): 10 ppm (deletion proposed) for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 5 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from the high vapor concentrations that may be present in the spill area and over some distance downwind. Direct contact and ingestion are also to be avoided.

Hazards of Skin or Eye Contact: Liquid pyridine and its concentrated vapors may cause moderate to severe irritation of the skin upon repeated or prolonged contact. Significant exposures may result in absorption of toxic amounts through the skin, occasional skin sensitization, and occasional photosensitization. Contact of the eyes with liquid pyridine and its solutions may cause a severe reaction with clouding of the cornea, scarring of the conjunctiva, and possibly permanent injury.

Hazards of Inhalation: Vapors of pyridine in air are irritating to the eyes, eye lids, and upper respiratory tract. High concentrations may cause narcosis, central nervous system depression, and gastrointestinal disturbance with symptoms including headache, dizziness, nervousness, nausea, vomiting, weakness, diarrhea, low back pain, urinary frequency, insomnia, and possibly loss of consciousness. Exposure of rats to 23,000 ppm (2.3%) was lethal in 1.5 hours, while exposure to 3600 ppm for 6 hours was fatal to 2 of 3 rats tested. A woman exposed to high levels for 15 to 20 minutes experienced speech disorders and "diffused cortical afflication" which receded after thiamine therapy. The symptoms did not occur for 10 hours, intensified until the third day, and did not involve the upper respiratory tract.

Hazards of Ingestion: Pyridine has a low to moderate acute oral toxicity. Nevertheless, ingestion of several ounces may cause severe vomiting, diarrhea, delirium, symptoms similar to those for inhalation, and death. Repeated doses are known to cause liver and kidney injury.

FIRE HAZARDS

Lower Flammable Limit: 1.8%

Upper Flammable Limit: 12.4%

Behavior in Fire: Flammable liquid. Vapors are heavier than air at warmer temperatures and may travel to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable gas or vapor upon release.

Hazardous Combustion Products: Thermal decomposition produces toxic cyanide fumes while combustion results in toxic oxides of nitrogen and carbon monoxide.

EXPLOSION HAZARDS

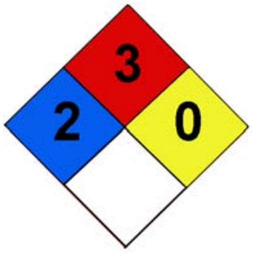
Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

1282

PYRIDINE
Class 3 (Flammable liquid)



PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor concentrations in air. Compatible materials may include butyl rubber and polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 250 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (250 ppm or less) or an organic vapor cartridge respirator with a full facepiece (250 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of eyes, skin, or upper respiratory tract; symptoms of narcosis and gastrointestinal disturbance.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention immediately if eye contact has occurred or skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: *Dry* chemical, carbon dioxide, alcohol foam, water spray or fog. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Use explosion-proof and spark-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the flammable and fairly volatile nature of pyridine into account while planning the response.

PYRIDINE
Class 3 (Flammable liquid)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent public exposure and to allow vapors or fumes to dissipate. Pyridine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases, particularly if large quantities have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Pyridine may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of pyridine in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to pyridine vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a some amount of pyridine from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . Alcohol foam applied to the surface of liquid pools may slow the release of pyridine vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid pyridine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

PYRIDINE
Class 3 (Flammable liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid pyridine may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCES

Contained pyridine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION : . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, sand and soda ash mixtures, earth, vermiculite, other inert mineral based materials, and possibly compatible cellulosic based or commercial sorbent materials.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL.. . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Motorized equipment may ignite any flammable vapors in the spill area.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Take proper precautions for the possibility of flammable vapors in the spill area.

PYRIDINE
Class 3 (Flammable liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users of contaminated water to stop or monitor water intake. Pyridine is fully soluble in water and will mix freely.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

TECHNIQUE

ABSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. Cation exchangers may also be effective where solutions are neutral or acidic. (Note: Pyridine solutions in water are normally weakly basic.)

CONSEQUENCE

Recovery of sorbents added to water may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe sorption techniques. Consider pumping water through tank containing sorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

RESIN SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid

GENERAL INFORMATION

Resin solution is a flammable usually dark brown colored liquid with an odor like hydrocarbon or solvent solutions. Resin solution covers a wide range of mixtures with varying constituents, some having more toxic constituents than others. It is used as a solvent and in manufacturing. Depending on the mixture, the liquid may be heavier than water but most sources report it to be lighter and only slightly soluble, so it may dissolve at a slow rate. Its lowest reported flash point of 0ºF indicates that the product can be ignited under all ambient temperature conditions. The product may generate heavier than air vapors and may travel a considerable distance to a source of ignition and flash back. Vapors also may persist in low areas. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat. The product weights approximately 5.8 to 9.7 pounds per gallon.

Resin solutions are not reported to react with water and is considered stable in normal transportation. It is reported to react vigorously with strong oxidizers, strong lewis or mineral acids, and strong mineral and organic bases, especially primary and secondary aliphatic amines and to be sensitive to static discharge. Products of combustion may include carbon monoxide, carbon dioxide and other gases originating from constituents. Product should be considered toxic, although it is highly dependent on the constituent components to ascertain true toxicity; primary routes of exposure are through inhalation or direct physical contact.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible, below 0.1%.
Solubility in Other Chemicals: Unavailable
Specific Gravity (Liquid): Varies; 0.7 - 1.17. Most report less than 1.
Vapor Density: Varies; one source reports 3.7
Boiling Point: Varies; 211 - 284ºF (99 - 140ºC)
Melting Point: Unavailable
Freezing Point: Unavailable
Molecular Weight: Varies
Heat of Combustion: Varies
Evaporation Rate (butyl acetate=1): 0.34
Vapor Pressure: Varies; 3.8 - 47 mmHg
Flash Point: Varies; 0 to over 100ºF (-17 to over 38ºC)
Autoignition Temperature: Varies; most sources do not report a value, however several sources suggest the range 765 - 930ºF (407 - 500ºC)
Burning Rate: Varies
Flammable Limits: Varies; 1.2% (LEL) - 28% (UEL)
pH: Most likely neutral
Stability: Stable
Polymerization Potential: Will not occur in most mixtures, however some mixtures may present the potential for polymerization.
Corrosiveness: None reported.
Reactivity with Water: No reactions reported.
Reactivity and Incompatibility: Can react vigorously with strong oxidizers, strong lewis or mineral acids, and strong mineral and organic bases, especially primary and secondary aliphatic amines. Sensitive to static discharge.

IDENTIFICATION

Shipping Name(s): Resin solution (USDOT & IMO).
Synonyms and Tradenames: Many types of resin solutions.
CAS Registry No.: Unavailable
Chemical Formula: Mixtures vary greatly
Constituent Components (% each): Constituents vary greatly between mixtures. Some common constituents are considered toxic and flammable.
UN/NA Designation: UN1866
IMO Designation: 3.1, 3.2 or 3.3, Flammable liquids
RTECS Number: Unavailable
NFPA 704 Hazard Rating: 2(Health): 3(Flammability): 0(Reactivity) Varies depending on constituents.
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Varies, common colors include dark brown and yellow and could even be colorless.
Odor Characteristics: Hydrocarbon or solvent odor.
Reportable Quantity: See appendix I.
Common Uses: Solvent and manufacturing.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

RESIN SOLUTION

Class 3 (Flammable Liquid) or
Combustible Liquid

or

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: None

Short Term Exposure Limit (STEL): No data for resin solution, refer to constituent components.

Time Weighted Average (TLV-TWA): No data for resin solution, refer to constituent components.

Ceiling (C) Limit: No data for resin solution, refer to constituent components.

IDLH: No data for resin solution, refer to constituent components.

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation or direct physical contact of high vapor concentrations that may be present. Ingestion is also to be avoided.

Hazards of Skin or Eye Contact: Skin contact with product or concentrated vapors may cause irritation, redness, and/or rashes. The product may be absorbed via skin in toxic amounts. Splashes of liquid in the eyes cause immediate and severe irritation.

Hazards of Inhalation: Inhalation may cause symptoms ranging from irritation of the respiratory tract headache, depression, nausea to coma.

Hazards of Ingestion: Ingestion may cause vomiting, diarrhea or headache and irritation of the mucous membranes.

FIRE HAZARDS

Lower Flammable Limit: 1.2%

Upper Flammable Limit: 28%

Behavior in Fire: Flammable liquid. Vapors may be heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate large quantities of flammable vapors upon release.

Hazardous Decomposition Products: Varies based on constituent products. May include carbon monoxide, carbon dioxide, silicon dioxide and formaldehyde.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

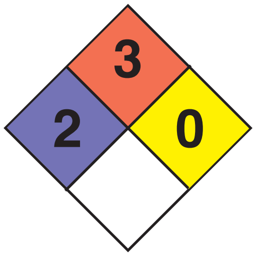
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices. This is highly dependent on the make up of the individual product mixture.

1866

RESIN SOLUTION

Class 3 (Flammable Liquid) or
Combustible Liquid



FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues and eyes; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Due to the extreme variations of the product, vomiting should be determined only by a qualified health care provider. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, water spray, foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of product may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe equipment. Take into account while planning a response that product is volatile, flammable, possibly highly toxic, and easily ignited.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

RESIN SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

COVERAGE WITH WATER . . . Coverage of confined liquid with a blanket of water may slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may be mobile in soil and may seep through dike material, which may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

RESIN SOLUTION

Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT . . . Spilled product may sink in water. Use natural deep-water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination. (Note: This technique is only for those mixtures that have a specific gravity greater than 1.)

CONSEQUENCE

Excavation of deep-water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

RESIN SOLUTION
Class 3 (Flammable Liquid) or Combustible Liquid

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product. (Note: This technique is only for those mixtures that have a specific gravity less than 1.)

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert to conditions that may lead to overflow or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

WATER UNDER-FLOW DAMS . . . Streams may be provided with a under-flow dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of under-flow tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

SILICON TETRACHLORIDE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Silicon tetrachloride, also known as silicon chloride, is a colorless to light yellow fuming liquid with a sharp acrid, pungent, and suffocating odor. It is highly toxic by inhalation and corrosive. The gas is colorless but the fumes are white in moist air. It hydrolyzes to hydrochloric acid on contact with moisture. The product is used in laboratories and in making smoke screens, ethyl silicate and similar compounds, silicones, high purity silica, and fused silica glass. Although the product is not itself flammable, containers may rupture due to increasing pressure if exposed to excessive heat or fire for sufficient time duration. The product weighs approximately 12.4 pounds per gallon.

Silicon tetrachloride is quite volatile and reacts vigorously with water to generate heat, hydrochloric acid, and a gelatinous siloxane. The product and its fumes and vapors are highly corrosive to all bodily tissues and will attack most metals when water is present, possibly with the evolution of flammable and potentially explosive hydrogen gas. Reactions with sodium or potassium may be explosive and the product is also reactive with a wide variety of other chemicals and substances. Decomposition products in a fire may include toxic chlorine, silicon dioxide, and hydrogen tetrachloride gases.

Downwind evacuation should be considered if a spill of silicon tetrachloride generates large amounts of vapors and fumes. These fumes and vapors are heavier than air and may persist in pits, hollows, and depressions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts vigorously, see below.
Solubility in Other Chemicals: Soluble in carbon tetrachloride, tin tetrachloride, titanium tetrachloride, sulfur mono and ditetrachlorides, benzene, and ether.
Specific Gravity (Liquid): 1.483 at 68ºF (20ºC)
Vapor Density: 5.9
Boiling Point: 135.7ºF (57.6ºC) at 1 atm.
Melting Point: -89.9 to -94ºF (-67.7 to -70ºC)
Freezing Point: -94ºF (-70ºC)
Molecular Weight: 169.9
Heat of Combustion: Not flammable.
Evaporation Rate (butyl acetate=1): 20
Vapor Pressure: 200 mmHg (3.87 psia) at 69.8ºF (21ºC)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable Limits: Not flammable
Stability: Stable, but reacts with water or moist air.
Polymerization Potential: Will not occur.
pH: Unavailable
Corrosiveness: Attacks most metals when water present; practically no action on iron, steel, or common metals or their alloys when dry.
Reactivity with Water: Reacts vigorously with evolution of heat, hydrochloric acid, and gelatinous siloxane.
Reactivity and Incompatibility: Reacts with sodium, potassium, alcohols, and a wide variety of other chemicals and substances. Avoid strong acids and bases. Reacts violently and/or explosively with methyl sulfoxide and dimethylformamide.

IDENTIFICATION

Shipping Name(s): Silicon tetrachloride (USDOT & IMO)
Synonyms and Tradenames: Silicon chloride, Tetrachlorosilane.
CAS Registry No.: 10026-04-7
Chemical Formula: $SiCl_4$
Constituent Components (% each): 99.5% or more pure.
UN/NA Designation: UN1818
IMO Designation: 8, Corrosives
RTECS Number: VW0525000
NFPA 704 Hazard Rating: 3(Health): 0(Flammability): 2(Reactivity): Reacts with water
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless to light yellow.
Odor Characteristics: Sharp, acrid, pungent, suffocating.
Reportable Quantity: See appendix I.
Common Uses: Smoke screens; laboratory reagent; mfg. of ethyl silicate and similar compounds, silicones, high purity silica, fused silica glass, and other products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

SILICON TETRACHLORIDE

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive, volatile, and reactive liquid with hazardous fumes and vapors. Reacts vigorously with water to produce hydrochloric acid (See separate guide on hydrochloric acid). May evolve hydrogen gas in contact with certain metals when wet.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 5 ppm (ACGIH)

Ceiling (C) Limit: Unavailable, however, hydrogen chloride which is formed by the hydrolysis of silicon tetrachloride has a ceiling of 5 ppm.

IDLH: Unavailable, however, hydrogen chloride which is formed by the hydrolysis of silicon tetrachloride has an IDLH of 50 ppm.

Conditions to Avoid: Heat; contact with incompatible materials or water; runoff to sewers or water bodies; inhalation, ingestion, and direct physical contact; sparks or fire where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Silicon tetrachloride is highly corrosive to all bodily tissues by all routes of exposure. Major hazard to public is inhalation of vapors or fumes in air, but ingestion and direct physical contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with liquid silicon tetrachloride may cause severe skin burns. Contact with the eyes may cause tearing and inflammation, swelling of tissue, and possible destruction or permanent impairment of the eyes.

Hazards of Inhalation: Vapors and fumes of silicon tetrachloride are extremely irritating and may cause difficult breathing, burning sensations, coughing, wheezing, laryngitis, headache, nausea, and vomiting. Severe exposures may be fatal as a result of spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. (Note: Latter effects may be of delayed onset.)

Hazards of Ingestion: Ingestion may cause severe internal injury with pain in the throat and stomach, intense thirst, difficulty in swallowing, nausea, vomiting, and diarrhea. In severe cases, collapse and unconsciousness may occur.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. May generate large quantities of corrosive vapors and fumes upon release.

Hazardous Decomposition Products: Decomposition may produce toxic chlorine, silicon dioxide, and hydrogen tetrachloride gases.

EXPLOSION HAZARDS

Explosive Potential: Very reactive. Not flammable but containers may rupture violently in fire due to overpressurization. Contact with certain other chemicals such as sodium or potassium may result in formation of explosive mixtures. Hydrogen gas evolved in reactions with some metals may explode if ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Teflo$^{®}$ is reported to provide more than 4 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece.

1818

SILICON TETRACHLORIDE

Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If unconscious, administer artificial respiration. Administer amyl nitrite by crushing pearl in a cloth and lightly holding under nose 5 times for 15 seconds at about 15 second intervals. Repeat every 5 minutes as necessary for 3-4 pearls. Administer oxygen if victim remains unconscious or breathing is difficult. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water, lime water, or milk of magnesia immediately. Do not induce vomiting. Get medical attention immediately. Do not give sodium bicarbonate.

Note to Physician: The primary hazard from silicon tetrachloride results from formation of hydrochloric acid upon contact with moisture. Vapors may produce delayed corneal and pulmonary injury. Delayed onset pulmonary edema may occur upon massive overexposure, and secondary infection may occur in the chemically inflamed respiratory tract. Cases of overexposure should be kept under observation. Mediastinitis from esophageal perforation, or peritonitis from gastric perforation may occur upon ingestion. Aspirated silicon tetrachloride can produce severe lung damage. Due to the severely irritant nature of this material, gastric lavage should be carried out with caution.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, or dry sand on adjacent fires. Product reacts with water or foam but may consider using large amounts of water fog or spray if large quantities of combustibles are involved.

Extinguishing Techniques: Corrosive vapor of fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to container rupture potential. Use water from side and from safe distance to keep fire exposed containers cool. Note: Addition of water may increase evolution of fumes from leaking product.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note: Contact with some metals in the presence of moisture may evolve hydrogen gas. Use intrinsically safe equipment where necessary.

SILICON TETRACHLORIDE
Class 8 (Corrosive Material)

AIR RELEASE

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to silicon tetrachloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point downwind of the spill and should not be allowed to contact pools of silicon tetrachloride, as this will increase fume evolution.

CONSEQUENCE

Water runoff may contain varying amounts of silicon tetrachloride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid silicon tetrachloride from a safe distance may eventually slow the release of vapors fumes into the atmosphere. This response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

OIL APPLICATION . . . Application of a fuel oil no. 6 to the surface of liquid pools may reduce emissions of vapors or fumes. This may be done at the same time that a neutralization agent is applied.

CONSEQUENCE

Addition of oil will increase the volume of spilled product.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

SILICON TETRACHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid silicon tetrachloride may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Silicon tetrachloride may be confined by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Confined silicon tetrachloride may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Removed confined product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

SILICON TETRACHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

August 1996

SODIUM ALUMINATE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Sodium aluminate is a colorless and odorless corrosive water solution of a granular hygroscopic solid (white crystalline powder) that is produced from the reaction of hydrated alumina with sodium hydroxide. Other manufacturing processes include the fusion of sodium carbonate with aluminum acetate, or by heating bauxite with sodium carbonate and extracting sodium aluminate with water. Sodium aluminate is used primarily in printing on fabrics, manufacture of milk glass, soap, hardening building stones, sizing improver and filler retention aid in the paper industry, and in water purification processes. Sodium aluminate normally contains an excess of sodium hydroxide or soda ash to maintain a sufficiently high pH to prevent aluminum hydroxide precipitation prior to its addition as a coagulant in municipal water treatment.

Sodium aluminate is corrosive and may cause caustic burns on direct contact to the skin and eyes. Inhalation may cause severe irritation to the nose, throat and respiratory tract. The most common route of exposure is through skin contact. Exposure may cause irritation of the mouth and throat.

Although the fire potential for sodium aluminate is low when exposed to sources of heat and flame, it can react with oxidizing materials. When heated to decomposition, the burning material may generate toxic and irritating fumes. Normal structural firefighting protective clothing will provide only limited protection for releases where sodium aluminate is present. Runoff may be corrosive and/or toxic. Sodium aluminate is water soluble. This material is stable, however it will react with strong acids and generate heat and release toxic fumes.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble.
Solubility in Other Chemicals: Insoluble in alcohol.
Specific Gravity (Liquid): >1.5
Vapor Density: Not applicable.
Boiling Point: Not applicable.
Melting Point: 1650°C (3002°F)
Freezing Point: Not established.
Molecular Weight: 81.97
Heat of Combustion: Not established.
Vapor Pressure: Not established.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Flammable Limits: Not established.
Stability: Stable.
Polymerization Potential: Will not occur.
Evaporation Rate: Unavailable.
pH: 11.5 @ 1% aqueous solution.
Reactivity and Incompatibility: Incompatible with sources of heat and moisture, and strong oxidizers, acids, and bases.
Other Characteristics: When heated to decomposition, material emits irritating and toxic fumes.

IDENTIFICATION

Shipping Name(s): Sodium aluminate, solid or Sodium aluminate, solution
Synonyms and Tradenames: Aluminate, Sodium, Aluminum Sodium Oxide, Sodium Aluminum Dioxide, Sodium Aluminum Oxide, Sodium Metaaluminate, and Sodium-M-Aluminate. CAS Registry No: 1302-42-7
Chemical Formula: $NaAlO_2$
Molecular Formula: $NaAlO_2$
UN/NA Designation: UN2812 (solid); UN1819 (solution)
IMO Designation: 8
NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid (aqueous solution) / crystalline solid (granular or powder).
Physical Form as Released: Liquid (aqueous solution) / crystalline solid (granular or powder).
Color of the Shipped Material: Colorless to white.
Odor Characteristics: Odorless.
Common Uses: Sodium aluminate is used primarily in printing on fabrics, manufacture of milk glass, soap, hardening building stones, sizing improver and filler retention aid in the paper industry, and in water purification processes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

SODIUM ALUMINATE
Class 8 (Corrosive Material)

See "UN/NA Designation"
for other ID numbers.

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Material is corrosive to the eyes and skin upon direct contact. Prolonged exposure can cause caustic burns. Material is corrosive to tissue and metals.

Time Weighted Average (TLV-TWA): 0.6 ppm

Short Term Exposure Limit (STEL): Not established.

IDLH: Unavailable.

Conditions to Avoid: Heat, sparks, flame, moisture, incompatible materials such as strong oxidizers and acids.

HEALTH HAZARDS

Potential Health Effects: Sodium aluminate is corrosive to tissue and mucous membranes. Symptoms include caustic burns, sore throat, coughing, swelling, and itching. Individuals with preexisting eye, skin, or respiratory conditions may be more susceptible to the effects of this product.

Hazards of Skin and Eye Contact: Skin contact may cause skin irritation with rash, redness, itching, burning, swelling and caustic burns. Direct eye contact may cause severe irritation with tearing, pain or redness. Prolonged contact may cause caustic burns with permanent eye damage.

Inhalation Hazards: Inhalation may cause severe irritation in the nose, throat and respiratory tract, with sore throat pain and coughing. Potential central nervous system (CNS) effects may include nausea, headache, dizziness or general weakness.

Ingestion Hazards: Ingestion may cause caustic burns to the mucous membranes with pain. Swallowing and speech may also be difficult. Nausea, headache, vomiting and abdominal pain may also occur.

FIRE HAZARDS

Lower Flammable Limit: Not established.

Upper Flammable Limit: Not established.

Behavior in Fire: Sodium aluminate has a low fire potential. Although it will not readily ignite, it will burn if exposed to sources of heat and flame, and if it comes into contact with oxidizing materials.

Hazardous Decomposition Products: When heated to decomposition, toxic and irritating fumes may be liberated.

EXPLOSION HAZARDS

Explosive Potential: Low.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are natural rubber, nitrile rubber, polyvinyl chloride and neoprene. Structural firefighting protective clothing only provides a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

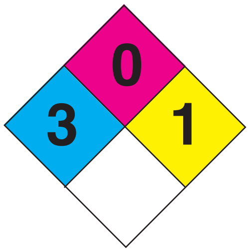
Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits.

1819

SODIUM ALUMINATE

Class 8 (Corrosive Material)

See "UN/NA Designation"
for other ID numbers.



FIRST AID

Nonspecific Symptoms: Direct skin contact can produce irritation, itching, inflammation, and burns. Central nervous system (CNS) effects may include nausea, headache, dizziness confusion or general weakness. Abdominal pain and sore throat may also occur.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician (preferably an eye specialist) from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, DO NOT INDUCE VOMITING due to the corrosive nature of the product. Give two (2) glasses of milk or water. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, or water spray.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Use water spray to cool fire-exposed containers and to protect personnel. Solid streams of water may be ineffective and scatter material. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be corrosive and/or toxic.

SPILL RESPONSES

General Information: Sodium aluminate is a corrosive material that may react with oxidizing materials, strong acids and moisture. Secure potential sources of heat, sparks, flame, impact, friction, electricity and moisture in the immediate spill area and downwind. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent contaminated runoff from entering sewers, waterways and storm drains. Underflow dams are not an effective means to dike material since it is water soluble and it is heavier than water. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered. Runoff may be corrosive and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer.

SODIUM ALUMINATE
Class 8 (Corrosive Material)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container of the liquid material is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent contaminated runoff from entering sewers, waterways and storm drains.

TECHNIQUE

MONITOR THE SITUATION...If released into the atmosphere, sodium aluminate is not expected to remain in the atmosphere for an extended period of time to present a significant hazard outside of the vicinity of the spill area. However, depending on the magnitude of the release and atmospheric/weather conditions, corrosive and/or toxic concentrations may take several hours to dissipate.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind.

MITIGATION

Evacuate the immediate area and down wind of the site of the release as conditions warrant. Personnel should conduct pH tests to determine if corrosive concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to protect tanks and exposures. Increases in spill sur face area and atmospheric conditions may increase the potential for migration of the spill away from the point of release.

CONSEQUENCE

Runoff may contain corrosive and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

FOAM...Firefighting foam may be used to control fires involving the material.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

SODIUM ALUMINATE
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, sodium aluminate is expected to undergo degradation. The time frame would depend on the size of the release and atmospheric conditions. Volatilization of sodium aluminate from water to the atmosphere is expected to be too slow to be environmentally significant. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is soluble in water. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may not be an effective means to recover spilled material since the material is 100% water soluble. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming will not be effective since the material is 100% water soluble and it is heavier than water.

CONSEQUENCE

Material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

SODIUM ALUMINATE
Class 8 (Corrosive Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...If released to soil, sodium aluminate is mobile and may leach into soil and migrate into ground water. Volatilization from either most soil or dry soil is not expected to occur to any significant extent. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Cover solid form of material with a plastic sheet or other compatible material. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be corrosive and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

October 1991

SODIUM CARBONATE
Non-Regulated

GENERAL INFORMATION

Sodium cabonate is not designated as a hazardous material in transportation but nevertheless has the potential to cause injury, and/or environmental pollution if improperly handled. It is ranked among the top 15 chemicals produced in the United States and may therefore be encountered comparatively frequently in transportation or other accidents resulting in a chemical discharge.

Solid sodium carbonate is shipped as white to greyish powders or lumps, some forms of which may appear as small white crystals or crystalline powders. Shipments may also consist of solutions in water or other liquids. This guide only addresses solid forms of sodium carbonate and solutions of the product in water.

Sodium carbonate is not flammable and has no odor. Its many uses include the making of aluminum, glass, other sodium compounds, substances derived from petroleum, soaps and cleaning agents, water softeners, paper, textiles, and other products. Solid forms are partially soluble in water and heavier. Aqueous solutions are soluble in all proportions.

Sodium carbonate does not react with water but dissolves therein with very considerable evolution of heat. Reactions with several other chemicals are known to be hazardous. It is of particular interest that sodium carbonate may explode on contact with red-hot aluminum. Aqueous solutions are highly caustic and therefore irritating and corrosive to bodily tissues with potentially immediate and severe effects. The substance is also reported to corrode aluminum, lead and iron. There appears to be a possibility that excessive heat may have the potential to cause sealed containers of solutions to rupture due to excessive steam pressure. Products of thermal decomposition in a fire may include toxic constituents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Partially soluble (solid); 7.1 g/100 g water at 32°F (0°C); 22 at 68°F (20°C); 45.5 at 212°F (100°C) for anhydrous sodium carbonate; a 1% solution of this substance in water has a pH of 11.5 which is strongly caustic (i.e., alkaline or basic). Solutions of hydrates with water will also be strongly caustic if in sufficient concentration. The solubility of hydrates vary with greater degrees of hydration associated with greater degrees of solubility. Aqueous solutions are soluble in water in all proportions.

Solubility in Other Chemicals: Soluble in glycerol

Specific Gravity (Solid): 2.53 at 68°F (20°C) for anhydrous sodium carbonate. Sodium carbonate monohydrate is somewhat lighter; reported values vary and include both 1.55 and 2.25 at unspecified temperatures. Values of 1.44 to 1.46 are reported for sodium carbonate decahydrate at unspecified temperatures.

Boiling Point: Anhydrous sodium carbonate is reported to slowly begin decomposing at 752°F (400°C); resulting substances include carbon dioxide (CO_2) and sodium oxide (Na20). The latter is a solid which is highly caustic and a strong irritant when wet with water.

Melting Point: 1563.8°F (851°C) is reported for both the anhydrous and monohydrate products; this temperature is well above that at which the anhydrous product is said to begin decomposing; 93.2°F (34°C) is reported by one authority as the melting point for the solid decahydrate.

Freezing Point: See melting point

Molecular Weight: 106.0 for anhydrous; 124.0 for the monohydrate; 286.0 for the decahydrate

Heat of Combustion: Not flammable

Vapor Pressure: Apparently negligible

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable with respect to any sort of hazardous activity in normal transportation. On exposure to air, the anhydrous product will gradually absorb moisture from the atmosphere (which is why the substance is considered hygroscopic). The monohydrate dries out somewhat in warm, dry air or above 122°F (50°C) and becomes anhydrous at about 212°F (100°C) or so. Elevated temperatures will also cause the decahydrate to lose water. Exposure to air will cause transparent crystals of the decahydrate to effloresce (i.e., to change to a powder from loss of water or to become covered with a powdery crust).

Corrosiveness: Sodium carbonate is reported to corrode aluminum, lead, or iron. It is not clear whether moisture must be present to cause corrosion when the anhydrous product is involved.

Reactivity with Water: No reaction; sodium carbonate dissolves in water with the evolution of considerable heat. Improper mixing with water has the potential to result in boiling and splattering. This can be avoided by mixing small amounts of sodium carbonate at a time into water.

Reactivity with Other Chemicals: One authority reports that reactions with acids generate heat and carbon dioxide; another states that sodium carbonate is decomposed by acids with effervescence. Caustics are generally considered reactive with varying results with a wide variety of other substances including acids, aldehydes, carbamates, esters.

IDENTIFICATION

Shipping Names: No particular name is standard but "Chemicals, n.e.c. (non-regulated)" is one possibility. The shipper may or may not provide the specific chemical name of the product. Do not confuse sodium carbonate with sodium percarbonate which is a regulated hazardous material classified as an oxidizer.

Synonyms and Tradenames: Anhydrous sodium carbonate is also known as carbonic acid, disodium salt; carbonic acid, sodium salt; soda; soda ash; Solvay soda; calcined soda; disodium carbonate; bisodium carbonate; anhydrous sodium carbonate; and sodium carbonate, anhydrous. Sodium carbonate monohydrate is also called crystal carbonate, soda monohydrate, and soda crystals. Sodium carbonate decahydrate is also known as washing soda, sal soda, soda, natron, natrite, and nevite.

Chemical Formula: Na_2CO_3 for anhydrous sodium carbonate; $Na_2CO_3.H_2O$ for the monohydrate; $Na_2CO_3.10H_2O$ for the decahydrate

Constituent Components (% each): Various grades exist, these being dense, light, extra light, natural, and refined according to one authority; these are likely to contain various amounts of the anhydrous and hydrated products.

28 STCC: 28 123 22 for anhydrous sodium carbonate or sodium carbonate monohydrate; 2812349 for sodium carbonate decahydrate

UN/INA Designation: Not established

IMO Designation: Not established

Physical State As Shipped: Solid powders, crystals, or lumps; solutions in water. (Note: Solutions with other liquids are not addressed in this guide.)

Physical State As Released: Same as shipped

Color of the Shipped Material: Solid forms of sodium carbonate are typically white to greyish powders or lumps; some forms may appear as small white crystals or crystalline powder. Aqueous solutions are most likely to be colorless.

Odor Characteristics: Odorless

Common Uses: Making aluminum, glass, sodium hydroxide, and other sodium compounds; used in soaps and strong cleaning agents, water softeners, pulp and paper manufacture, textile treatments, petroleum refining, photography, and various chemical processes; catalyst in coal liquefaction; food additive; reagent in analytical chemistry; used to control pH of water (in swimming pools and elsewhere).

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

SODIUM CARBONATE
Non-Regulated

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Although not designated as hazardous materials for transportation purposes, sodium carbonates may cause severe injury or death if improperly handled or if their known dangers of use are not heeded.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limit: Not established

Conditions to Avoid: Generation of airborne dust or mist; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion or direct physical contact; excessive heat or contamination of any kind.

HEALTH HAZARDS

Public Health Hazards: The primary hazard of the product is the irritation and potential burns it may cause to bodily tissues due to its alkalinity.

Hazards of Skin or Eye Contact: Relatively brief contact of the eyes with sodium carbonate or its highly alkaline (i.e., caustic) solutions may cause anywhere from mild irritation to severe irritation and reversible corneal injury depending on the nature and extent of exposure. Permanent injury may result if the substance is not quickly rinsed from the eyes with water. The solid and its dusts can cause mild to moderate skin irritation with redness and blistering, particularly if the exposure is repeated or prolonged. Authorities disagree on the effects of skin contact with concentrated alkaline solutions. Most report that these solutions are corrosive and may cause severe irritation and burns with development of what are referred to as "soda ulcers". Others report that a 50% solution applied to the intact skin of human volunteers caused little effect after exposure periods as long as 48 hours. Moderate redness and blistering occurred only if the skin had earlier been abraded; one-third of the volunteers showed tissue destruction at the abraded sites. One authority reports that sensitivity reactions may occur from repeated topical skin contact.

Hazards of Inhalation: Inhalation of dusts or mists containing sodium carbonate may cause irritation of the nose, throat and lungs with symptoms including coughing, sneezing, chest discomfort, and difficulty in breathing. Repeated or prolonged inhalation of moderate to high concentrations of sodium carbonate dust in air may result in damage or perforation of the nasal septum. The substance is considered moderately toxic by inhalation but it must be recognized that inhalation requires that an airborne dust or mist be somehow generated during or after discharge of the product. Laboratory experiments have shown that concentrations of 800, 1200, and 2100-2500 mg/m^3 of highly concentrated (91-95%) sodium carbonate aerosols were respectively required to cause deaths in 50% of guinea pigs, mice, and rats in two-hour exposures.

Hazards of Ingestion: Sodium carbonate is generally considered as mildly toxic by ingestion. Ingestion of large quantities of the product may produce corrosion and burns of the gastrointestinal tract resulting in abdominal pain, cramps, vomiting, diarrhea, circulatory system collapse, and possibly death. The oral LD^{50} for rats, the single dose causing death of 50% of the animals, is reported to be 4.09 g/kg of body weight.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Not flammable. Although not reported in the literature, it is conjectured that exposure of well-sealed containers of aqueous solutions to excessive heat may possibly cause generation of sufficient steam pressure to cause rupture of the container. The rupture may possibly take place with violence if the container is of strong construction (such as a metal drum).

Hazardous Combustion Products: Thermal decomposition of sodium carbonate is expected to produce carbon dioxide gas and solid sodium oxide (Na_20), a highly caustic and normally solid substance that is a strong irritant in the presence of moisture. One authority reports that sodium carbonate may liberate carbon monoxide or carbon dioxide and oxides of sodium in a fire. Hydrated products will also evolve water vapor or steam.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: May explode in contact with various other chemicals. Note especially that sodium carbonate may explode on contact with red-hot aluminum. See Behavior in Fire section directly above for a discussion of container rupture potential.

SODIUM CARBONATE
Non-Regulated

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye or skin contact with the spilled product. This may include rubber boots, gloves, face shields, tight-fitting dust or splash-proof safety goggles as needed, and other appropriate protective clothing such as coveralls, aprons, long-sleeved shirts, and so forth.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations of dusts or mists in air, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For other conditions, a NIOSH approved dust or mist respirator appropriate for the airborne contaminant levels present and selected by a qualified individual for use within the limitations of these devices.

FIRST AID

Nonspecific symptoms: Irritation of any bodily tissues

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration into the lungs and then repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Most extinguishing agents may be used on fires involving sodium carbonate. Various authorities list dry chemicals, carbon dioxide, alcohol foam, and water spray as appropriate. There is no readily apparent reason why regular foam cannot be used on adjacent fires involving other substances if it is appropriate for such substances. Keep in mind that substantial heat may be generated when solid sodium carbonate dissolves in water.

Extinguishing Techniques: Stay upwind. Avoid bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use professional judgment to decide if sealed metal drums or other containers or tanks exposed to excessive heat or fire should be kept cool via use of water sprays to avoid the possibility of container rupture due to buildup and pressurization of gases or steam in the container. If deemed necessary, use water from side and from safe distance to keep containers cool until well after fire is out. For a massive fire in the cargo area under these circumstances, it may be prudent to use unmanned hose holders or monitor nozzles. In any case, stay away from ends of tanks involved in fire (especially of solutions), but realize that shrapnel may travel in any direction. Be especially aware that contact of sodium carbonate with red-hot aluminum has been reported to result in an explosion.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers and water bodies. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or other hazard to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Keep the solid product dry if practical to avoid spread of contamination. The anhydrous product should be kept in tightly closed containers to avoid absorption of water from the atmosphere if practical. Take the alkalinity and corrosivity of sodium carbonate and its hydrates into account while planning the response. Note that substantial heat may be generated when solid sodium carbonate dissolves in water.

SODIUM CARBONATE
Non-Regulated

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium carbonate and its solutions may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed. (Note: In order to pose a significant downwind inhalation hazard when not involved in a fire, fairly large quantities of sodium carbonate dusts or mists must somehow become airborne.)

CONSEQUENCE

Hazardous levels of sodium carbonate may possibly be found in air in the local spill area and immediately downwind, particularly if solid product has been discharged.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

PROTECT10N FROM WIND . . . If necessary, cover solid sodium carbonate with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY.. . Water fog or spray applied to sodium carbonate dusts or mists in air may knock them down and accelerate their dispersal in the atmosphere. Apply water at a point downwind if solid sodium carbonate is exposed to prevent dissolution in water, attendant generation of heat, and spreading of contamination.

CONSEQUENCE

Water runoff may contain sodium carbonate from contact with its dusts or mists.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sodium carbonate and its solutions may be contained by building dikes or barriers using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Keep solid sodium carbonate dry to the extent possible. Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

SODIUM CARBONATE
Non-Regulated

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product, particularly solutions.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of solutions may be controlled by absorbing the liquid with sand, earth, clay, vermiculite, perlite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of a qualified expert. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques. (Note: Consult environmental authorities. It may be acceptable at times to carefully dilute sodium carbonate with water, to properly neutralize it with agents such as acetic acid or hydrochloric acid, and to flush the resulting liquid into a sewer.)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product or its residues may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause sodium carbonate dusts to become airborne.

MITIGATION

Select removal procedures that do not cause sodium carbonate dusts to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

SODIUM CARBONATE
Non-Regulated

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid sodium carbonate will sink in water and dissolve at a fairly rapid rate, particularly if water is plentiful compared to the amount of sodium carbonate spilled. Solutions of the product will dissolve freely in water and are highly caustic. A 1% solution of anhydrous sodium carbonate in water has a pH of 11.5.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: This may not be necessary in naturally acidic waters.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier- than-water solids that have not dissolved and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

January 1988

SODIUM CHLORATE
Division 5.1 (Oxidizer)

GENERAL INFORMATION

Sodium chlorate is an odorless pale yellow to white crystalline solid used for making herbicides, explosives, dyes, matches, inks, cosmetics, pharmaceuticals, defoliants, paper, and leather. It is appreciably soluble in water and heavier, so may be expected to sink and dissolve at a rapid rate. Although it is not itself flammable, the solid product and even 30% solutions in water are powerful oxidizing agents. Contact with wood, organic matter, ammonium salts, sulfur, sulfuric acid, various metals, and other chemicals may result in fires or explosions, particularly if any solid materials are finely divided. Excessive heat, as in fires, may cause evolution of oxygen gas that may increase the intensity of fires and may also result in explosions. Mixtures with combustible materials are very flammable and may be ignited by friction. The solid product weighs approximately 155.4 pounds per cubic foot.

Sodium chlorate does not react with water and is stable in normal transportation. Toxicity of the product varies with the route of exposure. Toxic fumes may be generated if it is involved in a fire.

If a fire involving bulk amounts of sodium chlorate becomes uncontrollable, evacuate for a radius of one-third (1/3) mile for protection from the effects of potential explosions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 79-230 g/100 g water in range 32-212°F (0-100°C)
Solubility in Other Chemicals: Soluble in alcohol, ammonia and glycerin.
Specific Gravity (Solid): 2.49 at 59°F (15°C)
Boiling Point: Decomposes
Melting Point: 478-502°F (248-261°C)
Freezing Point: 478-502°F (248-261°C)
Molecular Weight: 106.44
Heat of Combustion: Not flammable
Vapor Pressure: Data unavailable; probably very low
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Decomposes at or above 572°F (300°C) with evolution of oxygen; decomposition may be self-sustaining.
Corrosiveness: Corrosive to steel; moisture accelerates corrosion.
Reactivity with Water: *No* reaction
Reactivity with Other Chemicals: Reacts with wood, organic matter, oxidizable materials, ammonium salts, sulfur, sulfides, phosphorus, acids, arsenic, copper, zinc, aluminum, possibly other metals, manganese dioxide, potassium cyanide, and thiocyanates.

IDENTIFICATION

Shipping Names: Sodium chlorate (USDOT and IMO); chlorate of soda (USDOT); sodium chlorate, solution (IMO).
Synonyms and Tradenames: Chloric acid, sodium salt; soda chlorate; chlorate of soda; Drop leaf; De-fol-ate; Fall; Klorex; Kusatol; Ortho C-11; Shed-a-leaf; Tumbleaf; Val-drop.
Chemical Formula: $NaC10_3$
Constituent Components(% each): 99-99.5% pure solid; various strength solutions with water.
49 STCC: 49 187 23
UN/NA Designation: UN1495; UN2428 (IMO) (aqueous solution)
IMO Designation: 5.1, oxidizing substance
Physical State as Shipped: *Solid* or aqueous solution
Physical State as Released: Solid or aqueous solution
Color of the Shipped Material: Pale yellow to white solid; colorless solution.
Odor Characteristics: Odorless
Common Uses: Mfg. herbicides, explosives, dyes, matches, inks, cosmetics, pharmaceuticals, defoliants, paper; tanning of leather.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

SODIUM CHLORATE
Division 5.2 (Oxidizer)

See UN/NA Designation for
other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Powerful oxidizer. May cause fires or explosions in contact with a wide variety of materials. May explode if heated.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, sparks or friction; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: The toxic hazard of sodium chlorate is apparently considered to be low during normal handling, but limited data are available. It is best, therefore, to minimize exposures.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with sodium chlorate may cause some degree of irritation. Tissues may be damaged due to thermal and oxide effects.

Hazards of Inhalation: Data unavailable. Expect inhalation of dusts or mists to minimally cause irritation of mucous membranes.

Hazards of Ingestion: Ingestion of a toxic dose may cause gastrointestinal pain, vomiting, diarrhea, respiratory difficulties, kidney and liver injury, gastrointestinal congestion and corrosion, possible cyanosis, and possibly death. One authority reports that only ingestion produces symptoms of poisoning. The lethal oral dose for adults is about 15 grams (0.5 ounce).

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May melt and then decompose to emit oxygen gas that increases fire intensity. Prolonged exposure to fire or heat may result in container explosion. Reacts explosively with all organic matter and some metals.

Hazardous Combustion Products: Toxic fumes generated; may include chlorine and chlorine dioxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Not pertinent

Upper Explosive Limit: Not pertinent

Explosiveness: Very reactive. Contact with certain other chemicals, oxidizable materials or finely divided metals may result in formation of explosive mixtures. Containers may explode if exposed to prolonged fire or heat.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing. Do not use leather gloves or shoes, or oils, greases or protective creams that may form explosive mixtures with chlorates.

Respiratory Protection: For fire fighting, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For normal handling, an approved particulate or dust respirator within the use limitations of such devices.

1495

See UN/NA Designation for
other ID numbers.

SODIUM CHLORATE
Division 5.2 (Oxidizer)

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or mucous membranes; symptoms of ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: Get medical attention immediately. If victim is conscious and without convulsions, induce vomiting. Do not make an unconscious or convulsing person vomit.

FIRE RESPONSE

Extinguishing Materials: Flood with water from safe distance.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Avoid contact with spilled product. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may be dangerous. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Keep spilled product away from combustible and other incompatible materials. Give special attention to the fact that sodium chlorate is a powerful oxidizer.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium chlorate may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of sodium chlorate in air may be found in the local spill area and immediately downwind if sodium chlorate dust becomes airborne.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium chlorate with a plastic sheet or other compatible material to prevent airborne dust. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

SODIUM CHLORATE
Division 5.2 (Oxidizer)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sodium chlorate and its solutions may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. Keep solid product dry.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of solutions may be controlled by absorbing liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause dust to become airborne. Mixtures of product with organic matter may be ignited by friction.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust. Take special precautions where incompatible materials are present.

SODIUM CHLORATE
Division 5.2 (Oxidizer)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES. . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques. (Note: Anion exchangers are of fair effectiveness.)

SODIUM CYANIDE, solid

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Sodium cyanide is a nonflammable white solid with a faint almond odor. It is used for treating metals and electroplating, for extraction of gold and silver from ore, and for making fumigants, insecticides, dyes, pigments, and a variety of other products and chemicals. The substance is highly soluble in water and heavier, so may be expected to sink and rapidly dissolve. It weighs approximately 99.8 pounds per cubic foot.

Sodium cyanide is stable in normal transportation but reacts mildly with water or moisture to evolve poisonous hydrogen cyanide (HCN) gas and form hydrocyanic acid. The rate of HCN production is generally slow unless the water or other liquid present is acidic, at which time large amounts of HCN may be evolved. Reactions with molten nitrates, molten nitrite salts, chlorates, nitric acid, other strong oxidizing agents, and peroxides may be explosive, and the product is reactive with a variety of other chemicals. Sodium cyanide is extremely poisonous by ingestion or by inhalation of its dust in air (or of any HCN gas evolved). Products of decomposition in a fire may include nitrogen oxides and carbon monoxide.

Downwind evacuation should be considered on a case by case basis if sodium cyanide has spilled. See Air Spill section.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 58.7 g/100 g at 68°F (20°C)
Solubility in Other Chemicals: Soluble in ammonia; slightly soluble in alcohol.
Specific Gravity (Solid): 1.6 at 68F (20°C)
Boiling Point: 2725°F (1496°C) at 1 atm.
Melting Point: 1044-1047°F (562-563.7°C)
Freezing Point: 1047°F (564°C)
Molecular Weight: 49.02
Heat of Combustion: Not flammable
Vapor Pressure: Negligible
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: Data unavailable.
Reactivity with Water: Reacts mildly to produce toxic hydrogen cyanide gas and hydrocyanic acid. Gas evolution accelerated by acidic water.
Reactivity with Other Chemicals: Reacts with nitrates, nitrite salts, chlorates, fluorine, nitric acid, other acids and acid salts, nitrides, alkali and alkaline earth elemental metals, expoxides, polymerizable compounds, peroxides, strong oxidizing agents, and a variety of other chemicals.

IDENTIFICATION

Shipping Names: Sodium cyanide (USDOT & IMO)
Synonyms and Tradenames: Cyanide of sodium; hydrocyanic acid, sodium salt; sodium cyanide, cyanobrik.
Chemical Formula: NaCN
Constituent Components(% each): Various grades available.
UN/NA Designation: UN1689
IMO Designation: 6.1, poisonous substance
Physical State as Shipped: Solid
Physical State as Released: Solid, granular or briquettes.
Color of the Shipped Material: White
Odor Characteristics: Faint bitter almond odor
Common Uses: Electroplating; metal treatment; gold and silver extraction; fumigants and insecticides; mfg. of dyes, pigments, other products and chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

SODIUM CYANIDE, solid

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly toxic HCN gas is evolved in reactions with moisture or water. Product is extremely poisonous by ingestion or inhalation.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): (Skin) 5 mg/m^3 as CN over each 8 hours of a 40 hour work week (ACGIH)

Conditions to Avoid: Contact with water, moisture, or incompatible materials; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Sodium cyanide is poisonous by all routes of exposure, particularly inhalation and ingestion. Another major hazard to public from spills may be the poisonous hydrogen cyanide gas evolved in reactions with water or moisture in air.

Hazards of Skin or Eye Contact: Skin contact with sodium cyanide may cause itching, discoloration, corrosion, allergic contact dermititis, and caustic burns if exposure is prolonged. Contact with the eyes may result in severe injury. Sodium cyanide can be absorbed through the skin or eyes in toxic and fatal amounts.

Hazards of Inhalation: Sodium cyanide dust in air is irritating to the upper respiratory tract and eyes. High concentrations may cause symptoms of ingestion (see below) or death.

Hazards of Ingestion: Ingestion of very small amounts may result in weakness, dizziness, headache, vomiting, coma, convulsions, and or death. Effects may occur rapidly (if stomach empty) or may be delayed up to an hour. Relapses may occur after treatment.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Non-flammable solid

Hazardous Combustion Products: Decomposes to nitrogen oxides and carbon monoxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Contact with various other chemicals may result in formation of explosive mixtures. See General Information section.

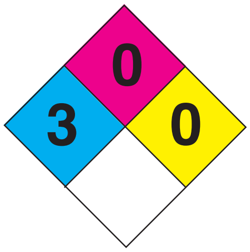
PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 5 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1689

SODIUM CYANIDE, solid
Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Eye or skin irritation, weakness, dizziness, headache, vomiting, others.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Get medical attention immediately. If unconscious, administer artificial respiration. Administer amyl nitrite by crushing pearl in a cloth and lightly holding under nose 5 times for 15 seconds at about 15 second intervals. Repeat every 5 minutes as necessary for 3-4 pearls. Administer oxygen if victim remains unconscious or breathing is difficult. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: Keep victim quiet and warm. Get medical attention immediately. If victim is conscious, administer large quantities of water and induce vomiting. Give victim one pint of 1% solution of sodium thiosulfate and repeat in 15 minutes. If victim is unconscious, see treatment described above for inhalation.

FIRE RESPONSE

Extinguishing Materials: Foam, carbon dioxide, or dry chemical as appropriate for surrounding fire. Water may evolve HCN gas, but may consider using large quantities of water fog or spray if large quantities of combustibles are involved.

Extinguishing Techniques: Unusual toxic hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Note that addition of water may accelerate evolution of poisonous HCN gas from sodium cyanide.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Consider using a buddy system due to the HCN hazard. Keep solid sodium cyanide as dry as possible. Keep product distant from all acidic materials.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Solid sodium cyanide may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the solid is kept dry and a small amount is spilled.

CONSEQUENCE

Hazardous levels of sodium or hydrogen cyanide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

SODIUM CYANIDE, solid
Division 6.1 (Poisonous Material)

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow cyanide dust or gas to dissipate. The spilled product may expose downwind areas to toxic concentrations over considerable distances in some cases if it becomes wet with water or contacts acids.

CONSEQUENCE

Avoidance of exposure of cyanide dust or gas in air. Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance. Keep sodium cyanide as dry as possible.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium cyanide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to cyanide dust or gas in air may absorb vapors, knockdown dusts and or accelerate their dispersal in the atmosphere. Water should be applied at a point downwind of the spill site and should not be allowed to contact solid sodium cyanide on the ground.

CONSEQUENCE

Water runoff may contain varying amounts of cyanide from contact with dusts or gases.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Solid sodium cyanide or its solutions may be contained by building dikes or barriers using earth, sand, or similar materials.

CONSEQUENCE

Contained liquid solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. Keep solid sodium cyanide as dry as possible. Cover with plastic sheet or other compatible material as necessary to prevent wetting with water or acids.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material. Keep spilled product as dry as possible.

SODIUM CYANIDE, solid
Division 6.1 (Poisonous Material)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Agitation may cause toxic dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

SODIUM HYDROSULFIDE

Division 4.2 (Spontaneously Combustible) or Class 8 (Corrosive Material)

GENERAL INFORMATION

Sodium hydrosulfide is shipped as a colorless to lemon colored solid or as a pale yellow to dark greenish black (or amber to red) solution in water. Solutions are classified as corrosive materials, as is one form of the solid. A second form is classed as a flammable solid and exhibits the hazards common to such substances. In any case, the product is fully soluble in water and has the odor of rotten eggs. Solutions are not themselves flammable but continuously and slowly evolve hydrogen sulfide gas that is toxic, flammable, and potentially explosive if ignited while confined. Containers exposed to excessive heat for sufficient time duration may rupture violently. Solutions weigh about 10.8 pounds per gallon. The solid weighs about 111.7 pounds per cubic foot.

Sodium hydrosulfide is considered stable in normal transportation. Solutions containing 45% of this product are slightly corrosive to iron and steel and very corrosive to aluminum, zinc, and copper. Contact of sodium hydrosulfide with acids may result in the evolution of large quantities of hydrogen sulfide gas. Reactions with diazonium salts may be violent or explosive. The product is highly toxic and irritating and corrosive to bodily tissues. A key hazard is that inhalation of hydrogen sulfide gas numbs the sense of smell at high concentrations in air that are rapidly fatal. Decomposition under fire conditions produces additional hydrogen sulfide. Products of combustion are likely to include toxic sulfur compounds.

If sodium hydrosulfide is leaking (not on fire) and generating large amounts of hydrogen sulfide gas, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. Judgements must be made on case by case basis.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions.

Solubility in Other Chemicals: Soluble in alcohol and ether.

Specific Gravity (Liquid): 1.79 for solid; 1.3 at 60.1°F (15.6°C) for 45% solution.

Boiling Point: Solution boils at 212°F (100°C)

Melting Point: Varies with form.

Freezing Point: Solution is frozen mush at 59°F (17°C)

Molecular Weight: 56.06, 92.10, or 110.11; varies with form.

Heat of Combustion: Unavailable; solution not flammable

Vapor Pressure: Unavailable

Flash Point: Unavailable; solution not flammable

Autoignition Temperature: Unavailable; solution not flammable

Burning Rate: Solution not flammable

Stability: Stable, but evolves hydrogen sulfide.

Corrosiveness: 45% solution slightly corrosive to iron and steel, very corrosive to aluminum, zinc, and copper. Avoid alternate exposure of iron and steel to air and solution.

Reactivity with Water: Solution in water continuously and slowly evolves hydrogen sulfide gas. Crystals hydrolyze in moist air to sodium hydroxide and sodium sulfide.

Reactivity with Other Chemicals: Acids or heat accelerate gas evolution. Oxidizing agents precipitate elemental sulfur. Reactions with diazonium salts are violent or explosive.

IDENTIFICATION

Shipping Names: Sodium hydrosulfide (USDOT); sodium hydrosulphide (IMO)

Synonyms and Tradenames: Sodium sulhydrate; sodium bisulfide; sodium hydrogen sulfide; sodium mercaptan; sodium mercaptide.

Chemical Formula: NASH or $NASH.2H_20$ or $NASH.3H_20$

Constituent Components(% each): 40-45% in water 70-72% flakes.

UN/NA Designation: UN2318 IMO, USDOT, 4.2, spontanaously combustible; UN2949 (IMO, USDOT, 8, corrosive)

IMO Designation: 4.2, flammable solid; 8, corrosive

Physical State as Shipped: Liquid (solution) or solid

Physical State as Released: Liquid (solution) or solid

Color of the Shipped Material: Colorless needles to lemon colored flakes; pale yellow to dark greenish black or amber to red solution.

Odor Characteristics: Rotten eggs

Common Uses: Paper pulping; processing dyestuffs; dehairing hides; bleaching; ore flotation; fining agent in flint glass; mfg. of rayon, cellophane, chemical milling solutions, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

SODIUM HYDROSULFIDE

Division 4.2
(Spontaneously Combustible)
or Class 8 (Corrosive Material)

See "UN/NA Designation"
for other ID numbers.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration:: 0.0047 ppm

Unusual Hazards: Evolves toxic hydrogen sulfide gas. One form of solid is flammable and may be spontaneously combustible.

Short Term Exposure Limits(STEL): 15 ppm (hydrogen sulfide) for 15 minutes (ACGIH)

Time Weighted Average(TLV-TWA): 10 ppm (hydrogen sulfide) over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with acids or incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of sodium hydrosulfide or hydrogen sulfide. Ingestion and direct physical contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with solid sodium hydrosulfide or strong solutions may cause stains and slow healing burns of skin with scar formation. Dilute solutions, mists, or hydrogen sulfide gas may cause skin irritation. Eye contact with product may result in pain, tearing, sensitivity to light, conjunctival edema, and possibly corneal destruction.

Hazards of Inhalation: Inhalation may result in coughing, choking, irritation, headache, dizziness, weakness, and difficult breathing. Lung congestion, cyanosis, bloody sputum and chest tightness may follow in 6-8 hours. Severe exposures may cause brain damage and permanent loss of sense of smell. High levels of hydrogen sulfide in air numb the sense of smell and may be rapidly fatal.

Hazards of Ingestion: Ingestion may cause burns of the gastrointestinal tract, pain in throat and abdomen, nausea, vomiting, and diarrhea. Collapse, unconsciousness, and death due to respiratory paralysis may occur in severe cases.

FIRE HAZARDS

Lower Flammable Limit: 4.3% (hydrogen sulfide)

Upper Flammable Limit: 45% (hydrogen sulfide)

Behavior in Fire: Heat accelerates evolution of flammable hydrogen sulfide gas. Containers may rupture violently in fire.

Hazardous Combustion Products: Hydrogen sulfide and sulfur compounds.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Explosion may result if hydrogen sulfide gas is ignited in a confined area. Contact with diazonium salts may result in formation of explosive mixtures. Some unconfirmed possibility that dust of flammable solid may form explosive mixtures with air.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

SODIUM HYDROSULFIDE

Division 4.2
(Spontaneously Combustible)
or Class 8 (Corrosive Material)

2318

See "UN/NA Designation"
for other ID numbers.

FIRST AID

Nonspecific Symptoms: Eye, skin, or other irritations or burns; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of milk or water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Give fluids again if vomiting occurs naturally.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, water spray, or foam for flammable solid.

Extinguishing Techniques: Unusual toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Eliminate ignition sources. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that one form of the product is a flammable solid and that all forms may generate flammable and toxic hydrogen sulfide gas.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium hydrosulfide may not evolve large amounts of hazardous airborne contaminants in some outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of hydrogen sulfide in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

SODIUM HYDROSULFIDE

Division 4.2 (Spontaneously Combustible) or Class 8 (Corrosive Material)

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow dusts or gases to dissipate. Spills of this product may expose downwind areas to toxic concentrations over considerable distances, particularly if large amounts have spilled or conditions are correct for accelerated evolution of hydrogen sulfide gas.

CONSEQUENCE

Avoidance of exposure to hydrogen sulfide in air. Need to notify, organize, transport and house displaced persons. Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium hydrosulfide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

TECHNIQUE WATER FOG OR SPRAY . . . Water fog or spray applied to gases or dusts in air may absorb gases, knockdown dusts, and/or accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of chemicals.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sodium hydrosulfide may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained sodium hydrosulfide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. Keep solid product dry.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material. Keep solid sodium hydrosulfide dry.

SODIUM HYDROSULFIDE
Division 4.2 (Spontaneously Combustible)
or Class 8 (Corrosive Material)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled liquid may be controlled by absorbing liquid with sand, earth clay, fly ash, cement powder, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Solid product may pose fire and toxic dust hazard.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation. Eliminate ignition sources.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

SODIUM HYDROSULFIDE

Division 4.2 (Spontaneously Combustible)
or Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

SODIUM HYDROSULFITE

Division 4.2 (Spontaneously Combustible)

GENERAL INFORMATION

Sodium hydrosulfite is a white to yellowish or greyish crystalline powder (or flakes) with a faint sulfurous odor. It is used in the dyeing of fibers and textiles, for stripping dyes, for bleaching sugar, soap, oils or wood, and in making rubber and other products. It is moderately soluble and will dissolve rapidly in water. The product is a flammable solid that burns slowly. It may heat spontaneously in contact with moisture or air to the extent that nearby combustible materials may be ignited. Sodium bisulfite formed in contact with water is also likely to ignite upon drying. Decomposition of sodium hydrosulfite upon heating may release oxygen which supports combustion and reduces the effectiveness of suffocation type extinguishing agents like carbon dioxide. Under prolonged exposure to fire or heat, containers of the product may rupture violently.

Sodium hydrosulfite is incompatible with oxidizing agents, strong mineral acids, and strong inorganic acids. It forms an acidic corrosive solution in water. It is irritating to the skin and eyes and may damage nasal and respiratory passages if inhaled. Products of combustion include toxic sulfur dioxide gas.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 22-25.4 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alkalies

Specific Gravity (Solid): Unavailable

Boiling Point: Decomposes violently at 374°F (190°C) to SO_2, sodium sulfite, and thiosulfate.

Melting Point: Decomposes at 125.6°F (52°C)

Freezing Point: Unavailable

Molecular Weight: 174.13 for $Na_2S_2O_4$

Heat of Combustion: Unavailable

Vapor Pressure: Unavailable

Flash Point: Flammable solid

Autoignition Temperature: Unavailable

Burning Rate: Burns slowly, about like sulfur.

Stability: Stable when dry

Corrosiveness: Forms corrosive acidic solution with water.

Reactivity with Water: Oxidizes to sodium bisulfite and later to sodium bisulfate with evolution of heat. May ignite combustible materials in contact with moisture or air.

Reactivity with Other Chemicals: Incompatible with oxidizing agents, strong mineral acids, and strong organic acids.

IDENTIFICATION

Shipping Names: Sodium hydrosulfite (USDOT); Sodium hydrosulphite (IMO); Sodium dithionite (USDOT & IMO).

Synonyms and Tradenames: Sodium dithionite; sodium hydrosulphite; sodium sulfoxylate; vatrolite dithionous acid, disodium salt; dithionite, hyposulfite; hydrosulfite of soda.

Chemical Formula: $Na_2S_2O_4$; $Na_2S_2O_4.2H_2O$; $Na_2S_22O_4.7H_2O$

Constituent Components(% each): Various grades available.

UN/NA Designation: UN1384

IMO Designation: 4.2, spontaneously combustible

Physical State as Shipped: Solid

Physical State as Released: Solid

Color of the Shipped Material: White to grayish crystals, yellowish-white powder or flakes.

Odor Characteristics: Faint sulfurous odor, like SO_2.

Common Uses: Vat dyeing; stripping of dyes; bleaching sugar, soap, oils, groundwood; reagent; oxygen scavenger for synthetic rubber.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

SODIUM HYROSULFITE

Division 4.2

(Spontaneously Combustible)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Flammable solid. Heats spontaneously in moisture or air. Containers may rupture violently in fire.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, and sparks; contact with moisture, air, or incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major apparent hazard is from inhalation of dust in air. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with sodium hydrosulfite may cause irritation.

Hazards of Inhalation: Breathing sodium hydrosulfite dust may damage nasal and respiratory passages.

Hazards of Ingestion: Ingestion may result in gastrointestinal irritation, nausea, vomiting, and diarrhea.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Flammable solid. Containers may rupture violently in fire.

Hazardous Combustion Products: Toxic sulfur dioxide (SO_2) gas.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Containers may rupture violently in fire. Some unconfirmed possibility that dust may form explosive mixture with air.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). An approved dust respirator is apparently acceptable for normal handling

FIRST AID

Nonspecific symptoms: Irritation of eyes, skin, nose, or respiratory passages; symptoms of ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

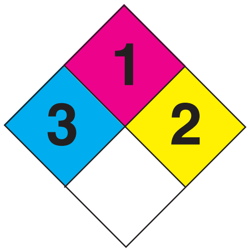
First Aid for Ingestion: If victim is conscious, administer water, milk, or salt water and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

1384

SODIUM HYROSULFITE

Division 4.2

(Spontaneously Combustible)



FIRE RESPONSE

Extinguishing Materials: Dry sand, carbon dioxide, dry chemical, and water. CO_2 and dry chemical may be ineffective. Avoid use of water unless flooding amounts are available.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Eliminate ignition sources. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that sodium hydrosulfite is a flammable solid.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium hydrosulfite may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of sodium hydrosulfite in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium hydrosulfite with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray may knockdown the dust of sodium hydrosulfite in air and or accelerate its dispersal. Try to keep water away from spilled solid on ground.

CONSEQUENCE

Water runoff may contain varying amounts of sodium hydrosulfite from contact with its dusts in the atmosphere.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

SODIUM HYROSULFITE

Division 4.2 (Spontaneously Combustible)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sodium hydrosulfite may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained solutions of sodium hydrosulfite may percolate into soil or seep through dike or material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material. Keep solid product dry.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Solid product poses fire and toxic hazards.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Eliminate ignition sources. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal .

SODIUM HYROSULFITE

Division 4.2 (Spontaneously Combustible)

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2000

SODIUM HYDROXIDE, (SOLID OR SOLUTION)

Class 8 (Corrosive Material)

GENERAL INFORMATION

Sodium hydroxide, also known as caustic soda, is a colorless, odorless and nonvolatile solid that may be shipped in flake, bead, or granular form or dissolved in water as a colorless solution. It is used in making rayon, cellophane, plastics, mercerized cotton, paper, explosives, dyestuffs and in a wide variety of other products and processes. It is quite soluble in water and will dissolve rapidly with the evolution of considerable heat that may generate steam and spattering. Although the product is not flammable, the heat generated by the solid upon contact with moisture may be sufficient to ignite adjacent combustible materials. Flammable and potentially explosive hydrogen gas may be generated upon contact of the wet product with metals such as aluminum, tin, lead, zinc, magnesium, chromium, brass, and bronze. The solid weighs approximately 132.9 pounds per cubic foot. Solutions weigh about 12.5 pounds per gallon.

Sodium hydroxide is stable in normal transportation. It is reactive with a variety of chemicals and corrosive to various metals, plastics, rubbers and coatings, and bodily tissues. Contact with nitromethane and other similar nitro compounds may result in the formation of shock-sensitive explosive salts. Sodium hydroxide will absorb moisture from the air and react with CO_2 from the air to form sodium carbonate.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Very soluble, 42-347 g/100 g H_2O for temperature range 32 - 212ºF (0 - 100ºC).

Solubility in Other Chemicals: Soluble in alcohol and glycerine.

Specific Gravity: 2.13 at 68ºF (20ºC) for solid; about 1.1 - 1.5 for solutions.

Vapor Density: >1

Boiling Point: Very high for solid, 2534ºF (1390ºC). Varies greatly for solution depending on concentration, 293 - 388ºF (145 - 198ºC).

Melting Point: See freezing point

Freezing Point: 604ºF (318ºC) for solid. Varies greatly for solution depending on concentration, 50 - 144ºF (10 - 62ºC).

Molecular Weight: 40.0 for NAOH

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): Unavailable

Vapor Pressure: Negligible; 1 - 1.5 mmHg

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Flammable Limits: Not flammable

Stability: Stable

Polymerization Potential: Will not occur.

pH: Solution is basic (alkaline); for a 50% solution the pH is 13-14.

Corrosiveness: Slowly corrosive to iron, copper, and monel. Will react with clothing, leather, and some metals. Will attack some plastics, rubber, and coatings.

Reactivity with Water: Dissolves in water with liberation of much heat, may steam and spatter.

Reactivity and Incompatibility: Avoid water or moisture. May react violently with acids, a number of organic compounds and some metals, such as tin, zinc, aluminum, bronze and brass - reactions with the these metals can generate flammable or explosive hydrogen gas. Reacts violently with many organics especially nitrogen containing organics, halogenated organics trichloroethylene and glycols. Reacts with acetaldehyde, acrolein, acrylonitrile, allyl alcohol, chloroform and methyl alcohol, chloronitrotoluene, maleic anhydride, nitromethane and other nitroparaffins, pentol, phosphorus, explosives, and organic peroxides.

IDENTIFICATION

Shipping Name(s): Sodium hydroxide, solid (USDOT & IMO); Sodium hydroxide, solution (USDOT & IMO).

Synonyms and Tradenames: Caustic soda; Lye; Soda lye; Sodium hydrate; White caustic; Spent sodium hydroxide; Spent neutralizing agent; Petroleum neutralizing agents.

CAS Registry No.: 1310-73-2

Chemical Formula: $NaOH$

Constituent Components (% each): $NaOH$ in water when solution. Percentage in solution varies widely.

UN/NA Designation: UN1823 (solid); UN1824 (solution)

IMO Designation: 8, Corrosives

RTECS Number: WB4900000

NFPA 704 Hazard Rating: 3(Health): 0(Flammability): 1(Reactivity); Reacts with water.

Physical Form as Shipped: Solid or liquid solution

Physical Form as Released: Solid or liquid solution

Color of the Shipped Material: White solid, flakes, sticks or pellets; colorless or milky solution.

Odor Characteristics: Odorless

Reportable Quantity: See appendix I.

Common Uses: Mfg. mercerized cotton, paper, explosives, dyestuffs, rayon, cellophane, plastics; used in petroleum refining, rubber reclamation, metal cleaning, zinc extraction, tin plating, oxide coating, laundering, bleaching, dishwashing, and in chemical processing.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

SODIUM HYDROXIDE,
(SOLID OR SOLUTION)

Class 8 (Corrosive Material)

*1823 (Solid) 1824 (Solution)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Solid evolves considerable heat in contact with water when solid. Heat may ignite combustible materials. Reaction with some metals evolves hydrogen gas.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: 2 mg/m^3

IDLH: 10 mg/m^3

Conditions to Avoid: Contact with incompatible materials; fire or sparks where hydrogen may be present; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact of the skin with sodium hydroxide as a solid or in dusts, mists, or solutions may cause skin irritation, and with greater exposure, severe burns with scarring. Similarly, contact with the eyes may result in irritation, severe burns, and possible blindness. YOU MAY HAVE 10 SECONDS OR LESS TO AVOID SERIOUS PERMANENT EYE DAMAGE.

Hazards of Inhalation: Breathing of sodium hydroxide dust or mist may cause effects ranging from mild irritation of the nose at 2 mg/m^3 in air to severe pneumonitis depending on the severity of exposure.

Hazards of Ingestion: Ingestion may result in severe burns of the mouth, throat and stomach, severe pain, vomiting of large pieces of mucosa, and possibly death. Scarring of the throat has caused squamous cell carcinomas of the esophagus in some cases many years after ingestion.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: No special hazards apparent. Some remote chance that containers may rupture in fire.

Hazardous Combustion Products: Sodium oxide. Decomposition by reaction with certain metals, such as aluminum, magnesium, tin and zinc, releases flammable and explosive hydrogen gas.

EXPLOSION HAZARDS

Explosive Limit: Not flammable

Explosive Potential: Contact with nitromethane, other similar nitro compounds, and certain other chemicals may result in formation of explosive mixtures. Contact with metals may generate hydrogen gas that may explode if ignited in confined spaces. Some remote chance that containers may rupture in fire.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing for solids or liquids (as appropriate). Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high dust or mist concentrations in air. Butyl rubber, neoprene, nitrile rubber and polyvinyl chloride are reproted to provide more than 8 hours of protection. Other compatible materials may include natural rubber, neoprene/styrene-butadiene rubber, polyethylene, chlorinated polyethylene, polyurethane and polyvinyl alcohol for the solid and its solutions, as well as nitrile rubber/PVC, styrene-butadiene rubber, Viton®, nitrile-butadiene rubber, and Saranex® for 30-70% solutions.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 mg/m^3) a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, a high efficiency mist and particulate filter respirator with a full facepiece within the use limitations of such devices. (Note: Respiratory protection may not be required for solutions in the absence of airborne mists.)

1823

1824

SODIUM HYDROXIDE, (SOLID OR SOLUTION)

Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 30 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: As necessary for surrounding fire, but note that much heat is evolved when water contacts solid product. NFPA suggests flooding with water, using care not to spatter or splash the product.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources where hydrogen may be present. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that contact of wet sodium hydroxide with some metals may generate hydrogen gas. Use intrinsically safe equipment where necessary. Note that the heat of reaction of the solid with water may be sufficient to ignite combustible materials.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists. (Note: Solutions do not pose a problem unless an airborne mist is somehow generated. In the event a mist is generated, follow guidelines for water fog or spray below.)

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

SODIUM HYDROXIDE, (SOLID OR SOLUTION)

Class 8 (Corrosive Material)

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium hydroxide with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid sodium hydroxide may slow the release of vapors into the atmosphere in some cases. Apply water cautiously at first to ensure that a hazardous reaction does not take place.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to sodium hydroxide vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Note: Sodium hydroxide has the potential to react with water, and should be used with caution and applied upwind from source of spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of sodium hydroxide from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may confine spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may seep through dike material, which may result in loss of confined product and spread of contamination. There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. (Note: Sodium hydroxide has the potential to react with water, and should be used with caution and applied upwind from source of spill.) Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil. Keep solid product dry.

SODIUM HYDROXIDE, (SOLID OR SOLUTION)
Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination if some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. (Note: Sodium hydroxide has the potential to react with water, and should be used with caution and applied upwind from source of spill.) Be alert to condition such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled liquid pools confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid sodium hydroxide may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Excessive agitation may cause sodium hydroxide dust to become airborne.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors. Organize work to minimize dust generation.

SODIUM HYDROXIDE, (SOLID OR SOLUTION)
Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

SODIUM (METAL)

Division 4.3 (Dangerous When Wet)

GENERAL INFORMATION

Sodium is a silvery waxy metal that becomes grayish white upon exposure to air and may be shipped as a solid or molten liquid. It is used for making gasoline additives, electric power cable, sodium lamps, and various chemicals, and has several other specialized uses. The product may ignite spontaneously in air, and if ignited, burns violently with explosions that may cause spattering of the material. Contact with moisture or water causes a violent reaction that produces sodium hydroxide solution (see separate guide) and hydrogen gas. The heat of reaction may be sufficient to cause ignition or explosion of the hydrogen. The solid product weighs approximately 60.6 pounds per cubic foot and is slightly lighter than water.

Sodium is stable in normal transportation. Besides its reactivity with water, it is reactive with a very wide variety of chemicals and other products. Contact with nitromethane or other similar nitro compounds in the presence of moisture may cause formation of shock-sensitive explosive salts. Contact with any bodily tissues rapidly causes thermal and chemical burns. The fumes of burning sodium are highly irritating to the eyes, skin, and mucous membranes.

Due to the reactivity of sodium, do not use water, carbon dioxide, or halogenated extinguishing agents to fight sodium fires. Use dry graphite, soda ash, powdered sodium chloride (table salt), or other appropriate dry powder such as dry limestone. Note that sodium can be safety stored by submerging it in an oxygen free liquid such as kerosene or naphtha.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below
Solubility in Other Chemicals: Decomposes in alcohol; insoluble in benzene and ether.
Specific Gravity (Solid): 0.971 at 68°F (20°C)
Boiling Point: 1621°F (883°C) at 1 atm.
Melting Point: See freezing point
Freeing Point: 207.5°F (97.5°C)
Molecular Weight: 22.99
Heat of Combustion: Unavailable
Vapor Pressure: Negligible, 1 mm Hg (0.0193 psia) at 822°F (439°C)
Flash Point: Not pertinent
Autoignition Temperature: About 250°F (121°C) in moist air; 1637°F (892°C) in dry air.
Burning Rate: Unavailable
Stability: Stable when dry
Corrosiveness: Sodium hydroxide solution attacks clothing, leather, metals such as aluminum, lead, tin, zinc, chromium, brass, bronze and magnesium, and some plastics, rubbers, and coatings. Contact with metals may evolve hydrogen gas.
Reactivity with Water: Violent reaction generating sodium hydroxide solution, hydrogen gas, and much heat. Hydrogen may ignite.
Reactivity with Other Chemicals: Reacts with air, water, and a wide variety of halogens, oxides, azides, chlorides, halogenated organic compounds, acid, oxidizing materials, fluorides, bromides, metals, and iodides, as well as sulfur, selenium, hydrazine hydrate, hydroxylamine, carbon dioxide, nitromethane and similar compounds in the presence of moisture, and other substances.

IDENTIFICATION

Shipping Names: Sodium (USDOT & IMO)
Synonyms and Tradenames: Sodium; sodium atom; metallic sodium; natrium.
Chemical Formula: Na
Constituent Components(% each): About 99.95% pure
UN/NA Designation: UN1428
IMO Designation: 4.3, dangerous when wet
Physical State as Shipped: Molten liquid or soft solid
Physical State as Released: Molten liquid or soft solid
Color of the Shipped Material: Silvery white, grayish white
Odor Characteristics: Odorless
Common Uses: Tetramethyl and tetraethyl lead; titanium reduction; polymerization catalyst; nuclear reaction coolant; electric power cable; sodium lamps; sodium hydride and peroxide; photoelectric cells; automobile engine exhaust valve coolant; radioactive forms used in tracer studies and medicine.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

SODIUM (METAL)

Division 4.3 (Dangerous When Wet)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Reacts violently with water or moisture producing hydrogen gas and sodium hydroxide (NaOH) solution. May ignite spontaneously and burn violently. Sodium hydroxide solution may produce hydrogen gas in contact with some metals.

Short Term Exposure Limits(STEL): Unavailable

Time Weighted Average(TLV-C): 2 mg/m^3 (as NaOH) absolute ceiling limit. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with air, water, or incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact of sodium or resulting sodium hydroxide solutions with the skin or eyes may result in severe thermal and chemical burns.

Hazards of Inhalation: Although the risk of inhaling sodium in accidents not involving fire is low, the dust of sodium or mists of sodium hydroxide in air may be expected to cause effects ranging from mild irritation of the nose to severe pneumonitis depending upon the severity of exposure. The fumes of burning sodium are highly irritating to the eyes, skin, and mucous membranes.

Hazards of Ingestion: Ingestion of sodium may result in severe thermal and chemical burns of the mouth, throat, and stomach, severe pain, vomiting of large pieces of mucosa, and possibly death. Scarring of the throat by sodium hydroxide has caused squamous cell carcinomas of the esophagus in some cases many years after ingestion.

FIRE HAZARDS

Lower Flammable Limit: Not pertinent (4% for hydrogen)

Upper Flammable Limit: Not pertinent (75% for hydrogen)

Behavior in Fire: Flammable solid. May generate flammable gas upon release. Burns violently with explosions that may spatter material.

Hazardous Combustion Products: Highly irritating and toxic sodium oxides and sodium hydroxide.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Very reactive. Contact with nitromethane or other similar nitro compounds and moisture, or certain other chemicals, may result in formation of explosive mixtures. Contact with water and/or metals may generate hydrogen gas that may explode if ignited in confined spaces.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles, and other impervious and resistant clothing for solids or liquids (as appropriate). Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high dust or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 mg/m^3 in air for sodium hydroxide), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a high efficiency mist and particulate filter respirator with a full facepiece within the use limitations of these devices.

1428

SODIUM (METAL)

Division 4.3 (Dangerous When Wet)

FIRST AID

Nonspecifc symptoms:: Irritation or burns of bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution:Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing and carefully brush off any loose sodium on the skin. Wash affected body areas with copious amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Dry graphite, soda ash, powdered sodium chloride (table salt), or other dry powder like dry limestone. Do not use water, carbon dioxide, or halons. Avoid using soda-acid or conventional dry chemical (bicarbonate) extinguishers.

Extinguishing Techniques: Reacts violently with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent product from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account that contact with water and/or some metals may generate hydrogen gas. The solid may spontaneously ignite. Do not attempt to sweep up dry material.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium is unlikely to evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the sodium is kept dry and is not burning.

CONSEQUENCE

Hazardous levels of sodium in air may be found in the local spill area and immediately downwind under appropriate conditions.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

SODIUM (METAL)

Division 4.3 (Dangerous When Wet)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Molten sodium or sodium hydroxide solutions may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination. Contact of sodium with water may result in fire or explosion.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Keep solid dry and cover with oxygen free liquid like kerosene or naphtha.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Pools of sodium hydroxide solution may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of sodium hydroxide solutions may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify sodium hydroxide to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

SODIUM (METAL)

Division 4.3 (Dangerous When Wet)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper handling may result in fires or explosions. Excessive agitation may cause sodium dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for guidance in all cases. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Alkaline sodium hydroxide solution and hydrogen gas are formed by the reaction of sodium with water.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

January 1988

SODIUM NITRATE
Division 5.1 (Oxidizer)

GENERAL INFORMATION

Sodium nitrate is a white crystalline solid that is odorless and is used for making solid propellants, explosives, fertilizers, pharmaceuticals, and food additives. It is appreciably soluble in water and heavier, so may be expected to sink and rapidly dissolve. The substance is not flammable but is a strong oxidizer that may react with easily oxidizable materials (such as hydrocarbons or cellulosic materials) to cause ignition, violent combustion, or explosion. It also increases the flammability of any combustible substance and may accelerate burning. An explosion may result if sodium nitrate is involved in a fire. The product weighs approximately 141.5 pounds per cubic foot.

Sodium nitrate is stable in normal transportation and does not react with water. It is reactive with a variety of chemicals, and as noted above, may form potentially explosive mixtures, particularly if a combustible material is finely divided.

Toxicity is apparently relatively low by the various routes of exposure, but the product evolves toxic nitrogen oxide gases when involved in a fire.

If a fire involving bulk amounts of sodium nitrate becomes uncontrollable, evacuate for a radius of one-half (½) mile for protection from the effects of potential explosions.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 92-180 g/100 g water in range 77-212°F (25-100°C)
Solubility in Other Chemicals: Soluble in alcohol, methanol, and ammonia
Specific Gravity (Solid): 2.261
Boiling Point: 716°F (380°C); decomposes
Melting Point: 584°F (307°C)
Freezing Point: 584°F (307°C)
Molecular Weight: 84.99
Heat of Combustion: Not flammable
Vapor Pressure: Low
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable, may explode when heated in excess of 1000°
Corrosiveness: Data unavailable; relatively noncorrosive
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with oxidizable materials; mixtures with reducing agents may explode under heat or shock; may react explosively upon heating with aluminum, aluminum oxide, antimony, sodium thiosulfate, magnesium, sulfur and charcoal, cyanides, sodamide, acetates, thiocyanates, and hypophosphites.

IDENTIFICATION

Shipping Names: Sodium nitrate (USDOT and IMO)
Synonyms and Tradenames: Chile saltpeter; chile niter; caliche; chile nitrate; soda saltpeter; cubic niter; soda niter; nitratine.
Chemical Formula: $NaN0_3$
Constituent Components(% each): Relatively pure
49 STCC: 49 187 46
UN/NA Designation: UN1498
IMO Designation: 5.1, oxidizing substance
Physical State as Shipped: Solid granules or powder
Physical State as Released: Solid granules or powder
Color of the Shipped Material: White or transparent
Odor Characteristics: Odorless
Common Uses: Mfg. solid propellants, explosives, fertilizers, pharmaceuticals; food additive.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

SODIUM NITRATE
Division 5.1 (Oxidizer)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless

Unusual Hazards: Strong oxidizer that may ignite or form potentially explosive mixtures with a variety of materials. May explode if heated above 1832°F (1000°C).

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Sodium nitrate is apparently considered to be of low toxic hazard in normal handling. Limited data are available.

Hazards of Skin or Eye Contact: Contact with sodium nitrate may result in irritation of the skin or eyes.

Hazards of Inhalation: Breathing sodium nitrate dust may cause irritation of the mucous membranes.

Hazards of Ingestion: Ingestion of significant amounts of sodium nitrate may result in nausea, increased urination, diarrhea, collapse and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May accelerate burning of combustible materials. May fuse or melt. May explode

Hazardous Combustion Products: Include toxic oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: Not pertinent

Upper Explosive Limit: Not pertinent

Explosiveness: Contact with certain other chemicals or oxidizable materials may result in formation of explosive mixtures. The product may explode in fire particularly when heated in excess of 1000° F. (See General Information) .

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, safety goggles and other impervious and resistant clothing.

Respiratory Protection: For fire fighting, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For normal handling where dust is airborne, an approved dust respirator may be adequate within the use limitations of such devices.

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or mucous membranes.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Data unavailable. Get medical attention immediately.

1498

SODIUM NITRATE
Division 5.1 (Oxidizer)

FIRE RESPONSE

Extinguishing Materials: Flood with water, but note that large quantities of sodium nitrate may melt or fuse in fire and that water application may result in extensive scattering of molten material.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Avoid contact with spilled product. Eliminate ignition sources. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may corrode boilers or industrial process equipment. Take into account while planning the response that sodium nitrate is a strong oxidizer.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sodium nitrate should not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of sodium nitrate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Protect product from wind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sodium nitrate with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES'... Sodium nitrate may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Water solutions of sodium nitrate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination.

SODIUM NITRATE
Division 5.1 (Oxidizer)

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause sodium nitrate dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize airborne dust generation.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment or neutralizing techniques.

September 2003

STYRENE MONOMER, STABILIZED

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Styrene monomer is a clear, flammable liquid with a sharp pungent and disagreeable odor that may seem sweet at low concentrations. It is used to make resins, polyesters, plastics, paints and coatings, synthetic rubber, insulators, concretes and pharmaceuticals. It is slightly soluble in water and lighter, so may be expected to form a floating surface slick that dissolves very slowly. Its flash point of 88°F indicates that the product can be easily ignited at warmer ambient temperatures. Vapors may be slightly heavier than air at or above such temperatures and may travel some distance to a source of ignition and flash back. Accumulations of vapors in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 7.6 pounds per gallon.

Styrene monomer does not react with water or many other common materials. It is stable in normal transportation when inhibited to prevent self-polymerization. Polymerization may occur, however, if the product is heated above 149°F or contaminated by metal salts, peroxides or strong acids (and possibly other substances). The resulting reaction may result in violent container rupture. Styrene monomer may otherwise react with various chemicals, is corrosive to copper and its alloys and may dissolve certain rubber materials. Toxicity of the product is low to moderate via the various routes of exposure. Products of combustion may include acrid styrene fumes and other toxic gases.

Initial downwind evacuation should be considered for at least 300 meters (1000 feet) if styrene monomer is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.03 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, carbon disulfide, ether and petroleum ether.

Specific Gravity (Liquid): 0.906 at 68°F (20°C)

Vapor Density: 1.02 - 1.22

Boiling Point: 293.4°F (145.2°C) at 1 atm

Melting Point: See freezing point.

Freezing Point: – 23.1°F (– 30.6°C)

Molecular Weight: 104.15

Heat of Combustion: – 9782 cal/g

Evaporation Rate (butyl acetate=1): .5

Vapor Pressure: approx. 6 mm Hg (0.116 psia) at 68°F (20°C)

Flash Point: 88°F (31.1°C), closed cup; 93°F (33.9°C), open cup

Autoignition Temperature: 914°F (490°C)

Burning Rate: 5.2 mm/minute

Flammable Limits: 1.1% (LFL) - 6.1% (UFL)

Stability: Stable under normal temperatures and pressures. Forms peroxides or aldehydes in air and light.

Polymerization Potential: May occur. Uninhibited material may polymerize which becomes self-sustaining at temperatures above 149°F (65°C). Exposure to butyllithium, dibenzoyl peroxide, azoisobutyronitrile or di-tert-butylperoxide may cause violent polymerization.

Corrosiveness: Copper and its alloys are corroded. Some rubber materials may dissolve.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Reacts with metal salts, peroxides, strong acids, halogens, hydrogen halides, sodium hydroxide, glycols, catalysts for vinyl polymers, aluminum chloride and oxidizing agents.

IDENTIFICATION

Shipping Name(s): Styrene monomer, stabilized (USDOT & IMO)

Synonyms and Tradenames: Vinylbenzene; Vinylbenzol; Ethenylbenzene; Styrene; Phenylethene; Phenylethylene; Phenethylene; Styrol; Styrolene; Styron; Styrole; Styropol; Cinnamene; Cinnamol; Cinnamenol; Diarex HF 77.

CAS Registry No.: 100-42-5

Chemical Formula: $C_6H_5CH=CH_2$

Constituent Components (% each): 99.5% or more pure with trace of tert-butylcatechol as inhibitor.

UN/NA Designation: UN2055

IMO Designation: 3, Flammable liquids

RTECS Number: WL3675000

NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 2 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless to yellow oily liquid

Odor Characteristics: Pungent, sharp, disagreeable, sweet at low concentrations.

Reportable Quantity: See appendix I

Common Uses: Mfg. of resins, polyesters, plastics, paints and coatings, synthetic rubber, insulators, drugs, concretes and drugs.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

STYRENE MONOMER, STABILIZED
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.02-0.47 ppm

Unusual Hazards: Flammable liquid with vapors that may be heavier than air at warmer temperatures and that may travel to a source of ignition. May polymerize with violent container rupture if heated or contaminated by certain chemicals. Vapors are uninhibited and may form polymers in vents or flame arrestors resulting in stoppage. Toxic gases are produced in fire.

Short Term Exposure Limit (STEL): 100 ppm (425 mg/m^3) over 15-minute work period. (NIOSH)

Time Weighted Average (TLV-TWA): 50 ppm (215 mg/m^3) over each 8 hours of a 40 hour work week. (NIOSH)

Ceiling (C) Limit: 200 ppm (15-minute maximum peak in any 3 hours) 600 ppm (5-minute maximum peak in any 3 hours) (OSHA)

IDLH: 700 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in the spill area and immediately downwind. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid styrene monomer may result in drying, cracking and inflammation of the skin due to the defatting action of the product. Some amount may be absorbed through the skin. Contact with the eyes may cause irritation and possibly temporary corneal injury.

Hazards of Inhalation: Vapors of styrene monomer above 200 ppm in air may irritate the eyes and upper respiratory tract. Higher concentrations may cause narcosis and central nervous system depression with symptoms including headache, nausea, cramps, incoordination, dizziness, drowsiness, unconsciousness and possibly death due to respiratory paralysis. Exposure to only 376 ppm for one hour is sufficient to cause headache, nausea, loss of coordination and certain other effects.

Hazards of Ingestion: Moderately toxic. Ingestion may cause nausea, vomiting and loss of appetite (and possibly other symptoms of narcosis.)

FIRE HAZARDS

Lower Flammable Limit: 1.1%

Upper Flammable Limit: 6.1%

Behavior in Fire: Flammable liquid. May generate flammable vapors upon release. Vapors may be heavier than air and may travel to a source of ignition and flash back. Exposure of containers to fire or excessive heat may result in polymerization and violent container rupture. This material is lighter than water and insoluble in water. The fire could easily be spread by the use of water in an area where the water cannot be contained.

Hazardous Combustion Products: Include carbon monoxide, carbon dioxide, acrid styrene fumes and possibly other toxic gases.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Loss of inhibitor or excessive heat may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in the presence of certain chemical contaminants (see General Information section).

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

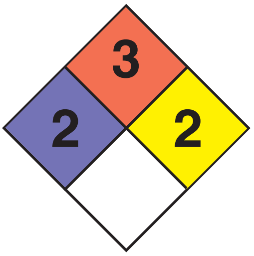
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This should include impervious and resistant clothing. Compatible materials may include polyethylene, polyvinyl alcohol, ethyl vinyl laminate and Viton®.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations (above 700 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted organic vapor canister or an organic vapor cartridge respirator with a full facepiece within the use limitations of these devices.

2055

STYRENE MONOMER, STABILIZED

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin or respiratory tract; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if skin irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Use water fog, dry chemical, carbon dioxide or foam concentrate suitable for hydrocarbon fires. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. This material is lighter than water and practically insoluble. The fire could easily be spread by the use of water in an area where the water cannot be contained. Dike fire control water for proper disposal since it may be flammable and/or toxic.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of styrene may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that styrene monomer is a flammable liquid subject to violent self-polymerization under conditions described in the General Information section. Consider not flushing spills since the material may float on water and may be carried off-site spreading the fire. Overflow dams may be used to dike material since it does not mix well with water and it is lighter than water. Spills may be absorbed with sand, clay or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with qualified experts. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Styrene monomer may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of styrene monomer in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

STYRENE MONOMER, STABILIZED
Class 3 (Flammable Liquid)

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Styrene spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to styrene vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point upwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of styrene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of styrene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, or in high wind conditions, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Styrene may be confined by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Confined material may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

STYRENE MONOMER, STABILIZED
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

STYRENE MONOMER, STABILIZED

Class 3 (Flammable Liquid)

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Sorbent pads or peat placed on upstream side of mesh should absorb and retard spreading of spilled product

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

WATER BY-PASS DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating styrene monomer.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Sorbent pads, peat or commercial sorbent materials compatible with styrene monomer may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

September 1992

SULFUR or MOLTEN SULFUR
Class 4.1 (Flammable Solid) or Class 9 (Miscellaneous Hazardous Material)

GENERAL INFORMATION

Sulfur, as addressed in this Guide, is shipped in the form of solid crystals, powders or prills; as a hot molten liquid; or as an emulsified solution of sulfur in water. Pure sulfur is odorless but common impurities may cause a rotten egg type odor, an oily odor, or even a sweet odor. All forms of sulfur are heavier than water and insoluble therein. Pure sulfur is yellow and changes to orange to red to black as its temperature increases according to one authority. Other possible colors, depending on the form, temperature, and purity of the product are reported to include amber, tan, brown, and gray. All forms of sulfur are combustible. Clouds of sulfur dust in air may burn or explode if ignited. Molten liquid above its flash point may evolve vapors that may travel to a source of ignition and flash back. It is conjectured that sealed tanks of emulsified aqueous solutions may possibly rupture if exposed to excessive heat for sufficient time duration due to steam pressure. Molten sulfur is typically shipped and stored at temperatures between 280°F (138°C) and 300°F (149°C) and may cause severe thermal burns upon contact. Violent generation of steam may result from introduction of water or another volatile liquid into molten sulfur or hot tanks, leading to tank rupture, personnel burns, and other hazards.

Sulfur reacts in a hazardous fashion with a wide variety of other chemicals and many metals, that molten sulfur may contain highly toxic and potentially flammable and explosive gases that are dissolved in the liquid and which may evolve from its surface, and that the gases, fumes, and smoke generated by burning sulfur are highly irritating and toxic. Indeed, these products of combustion (based on amount of sulfur burning, location, and weather conditions) may provide cause for a downwind evacuation or alternative public protective action ifa cargo of sulfur is ignited.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible; no specific data available.

Solubility in Other Chemicals: The best solvents are reported to be benzene, carbon disulfide, and carbon tetrachloride according to one authority.

Specific Gravity (Liquid): Depending on form and purity, reported values for solid sulfur range from 1.92 to 2.08 at room temperatures; approx 1.8 for the molten liquid.

Boiling Point: 832 - 832.5°F (444.4 - 444.7°C) at 1 atm.

Melting Point: Depending on the form and purity of the sulfur, reported values range from 224.2 - 251.6°F (106.8 - 122.0°C).

Freezing Point: See melting point

Molecular Weight: Elemental sulfur is considered to have an atomic weight of 32.06. The molecular weight of monoclinic and rhombic forms of sulfur (as Ss) is 256.5.

Heat of Combustion: - 2634 cal/g

Vapor Pressure: Less than 0.0001 mm Hg at 68°F (20°C) for pure solid; 1 mm Hg(0.01933 psia) at 362.84°F (183.8°C) for pure molten liquid without dissolved gases.

Flash Point: Reported as low as 335°F (168°C), closed-cup, for impure sulfur; the value reported for pure sulfur by several authorities is 405°F (207°C), closed-cup; yet others provide a value as high as 502°F (261°C).

Autoignition Temperature: 374°F (190°C) reported for sulfur dust in air; values reported for molten sulfur range from 450°F (232°C) to 511°F (266°C).

Burning Rate: Not available

Stability: Stable

Corrosiveness: Corrosive to copper and copper alloys and combines with nearly all metals under appropriate conditions. Molten sulfur may be stored in steel or stainless steel when corrosion is limited by avoiding exposure to air and moisture; it is also reported as generally compatible with iron and solid aluminum. Sulfur is both an oxidizing and reducing agent; it will form sulfides with most metals, including iron, and may react vigorously with metals in the sodium and magnesium groups of the periodic table. Molten sulfur may attack and degrade certain rubber and plastic substances. Its temperature is sufficiently high that some of these substances may melt or lose their strength.

Reactivity with Water: *No* reaction

Reactivity with Other Chemicals: Reactive with a very large number of other chemicals and substances. At higher temperatures, sulfur may react with hydrocarbons evolving poisonous hydrogen sulfide gas and carbon disulfide. Mixtures with powdered carbon or charcoal may ignite spontaneously. Seek additional information from qualified experts on the interaction of sulfur with specific substances where necessary. Space does not permit a full discussion of all known incompatible materials and their individual hazards.

IDENTIFICATION

Shipping Names: Sulfur; sulfur, molten

Synonyms and Tradenames: Flowers of sulphur; liquefied sulfur; precipitated sulfur; sublimed sulfur; sulfur flour; sulfur flower; and many tradenames and names reflecting the source or nature of the product.

Chemical Formula: "S" for elemental sulfur; "S_8" for monoclinic or rhombic crystals.

Constituent Components (% each): Solid sulfur is sold in many varieties and grades; molten sulfur is apparently 99% or more pure. One shipper of molten sulfur reports its product may contain some amounts (less than 1%) of dissolved hydrogen sulfide and/or sulfur oxide gases that may evolve from the liquid with time. These gases are highly toxic. Hydrogen sulfide is also flammable.

49 STCC: 49 457 70; 49 174 02; 49 174 03; 49 453 56

UN/NA Designation: NA1350 or UN1350 for "sulfur", which refers to the solid product; NA2448 or UN2448 for "sulfur, molten".

IM0 Designation: 9, miscellaneous hazardous material, for US shipments; 4.1, flammable solid, for international shipments.

Physical State As Shipped: Various forms of dry solid; emulsions of solid sulfur mixed with water; or hot molten sulfur.

Physical State As Released: As shipped; hot molten sulfur will solidify as it cools below its melting point. Be advised that a solid crust may form over molten sulfur and that the liquid underneath may remain hot for an extended period of time.

Color of the Shipped Material: Relatively pure sulfur is yellow and changes from lemon yellow to orange to red to black as its temperature increases according to one shipper. Another reports its product is bright yellow when solid and turns a yellow-amber color when molten.

Odor Characteristics: Pure sulfur is odorless; impurities may cause a rotten egg type odor, an oily odor, or even a sweet odor. Burning sulfur smells like burning match heads.

Common Uses: Making sulfuric acid and other chemicals, insecticides, plastics, enamels, metal-glass cements, dyes, gunpowder, matches, detergents, pharmaceutical products, explosives, rodent repellants and soil conditioners.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

SULFUR or MOLTEN SULFUR
Class 4.1 (Flammable Solid) or Class 9 (Miscellaneous Hazardous Material)

The Class 9 placard may
e used instead

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not available; pure sulfur is odorless. Impurities may have different characteristics.

Unusual Hazards: The space above the liquid in tanks of molten sulfur may contain toxic and flammable hydrogen sulfide gas under pressure; it is necessary to check carefully for pressure or vacuum before releasing all hatch hold-downs; the cover may try to spring open forcefully and/or material or gas may eject forcefully. Sulfur may remain molten under a solid crust for extended periods; check carefully before walking on such crusts. Violent generation of steam may result from introduction of water or another volatile liquid into molten sulfur or hot tanks, leading to tank rupture and/or personnel burns. Products of combustion are toxic, may irritate exposed skin, and may cause visibility problems in area of burning sulfur. Pressure relief devices on tanks of the molten liquid may be susceptible to plugging with solid and subsequent malfunction.

Short Term Exposure Limit (STEL): 5 ppm for sulfur dioxide; 15 ppm for hydrogen sulfide; both for 15 minutes (ACGIH, 1991- 92; OSHA, 1989). Not established for sulfur.

Time Weighted Average (TWA) Limits: For solid sulfur dusts, 10 mg/m^3 (total dust) over each 8 hours of a 40 hour work week (ACGIH TLV, 1990-91); 15 mg/m^3 (as total dust) and 5 mg/m^3 (as respirable fraction) under similar circumstances (OSHA PEL, 1989); all as exposure limits for "nuisance dusts". For other gases, 2 ppm for sulfur dioxide and 10 ppm for hydrogen sulfide over each 8 hours of a 40 hour work week (ACGIH, 1991-92; OSHA, 1989).

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, or direct physical contact. See "Unusual Hazards" for additional information.

HEALTH HAZARDS

Public Health Hazards: Pure sulfur poses a relatively low toxic hazard to the public when not burning and when not physically contacted as a molten liquid. Of far greater concern is the presence of dissolved hydrogen sulfide gas that may evolve from the molten liquid and the generation of sulfur dioxide and possibly other gases during combustion of the substance. These gases are highly toxic and pose a substantial risk to response personnel and downwind populations. See the Emergency Action Guides for sulfur dioxide and hydrogen sulfide for the respective inhalation hazards of these highly toxic gases.

Hazards of skin or Eye Contact: Contact of the eyes with sulfur dust may cause slight to severe irritation. According to one highly respected authority, an individual may be exposed for several hours or days to sulfur dust before beginning to develop a scratchy discomfort in the eyes which may progress to a burning sensation, lacrimation, blurring of vision, inflammation of the cornea, and loss of patches of the outer layer of the cornea. Recovery is usually spontaneous and complete within two or three days when exposure is discontinued. Contact of the eyes with molten sulfur may cause severe burns and permanent injury. Solid sulfur is only slightly irritating if at all to skin in brief exposures. Repeated or prolonged contact may cause reddening, itching, inflammation, and dryness of the skin, as well as possibly an allergic reaction in some people. Damaged, abraded, or cut skin may aggravate problems. Molten sulfur can adhere to skin, hair and clothes, causing thermal burns of severity depending on the amount and extent of contact. It is generally recognized that contact lenses should not be worn when working with chemicals because they may contribute to the severity of an eye injury.

Hazards of Inhalation: Sulfur dusts and mists may be irritating to the nose, throat and respiratory system, including the lungs, at relatively high concentrations in air. Repeated exposures may cause bronchitis to develop with symptoms including coughing, production of phlegm, and/or shortness of breath. Prolonged chronic exposures may cause bronchopulmonary disease potentially complicated by emphysema and lung injury (bronchiectasis). See the Emergency Action Guides for sulfur dioxide and hydrogen sulfide for the respective inhalation hazards of these highly toxic gases.

Hazards of Ingestion: Sulfur is of relatively low toxicity by ingestion. Single oral doses are reported to cause gastrointestinal disturbances with symptoms including irritation, nausea, vomiting, and diarrhea. Ingestion of large amounts (15 grams or more, presumably for an average adult) may result in formation of highly toxic hydrogen sulfide in the colon due to bacterial action if not removed via vomiting or other means. Other potential symptoms are reported to include convulsions, unconsciousness, an odor of hydrogen sulfide on the breath, changes in blood pressure and respiration, respiratory arrest, and possibly death. The lowest dosage reported to cause deaths among rabbits in laboratory experiments is 175 mg of sulfur per kilogram of the animal's body weight. Ingestion of molten sulfur will obviously result in severe burns of the mouth, throat, and internal organs.

1350

SULFUR or MOLTEN SULFUR
Class 4.1 (Flammable Solid) or Class 9 (Miscellaneous Hazardous Material)

FIRE HAZARDS

Lower Flammable Limit: 3.3 to 4.3% for hydrogen sulfide; reported values vary.

Upper Flammable Limit: 44 to 46% for hydrogen sulfide; reported values vary.

Behavior in Fire: Easily ignitable combustible solid or molten liquid. Additional heating of molten liquid may result in vapors that travel some distance to a source of ignition and flash back. Sulfur fires appear deep blue at night and have short flames. During daylight, the flames are pale blue and may be difficult to see or even invisible if not for the smoke and heat generated. The smoke from a fire is not only highly toxic via inhalation but may hinder visibility in the spill area. Upon contact with moisture or sweat, it may cause irritation and a burning sensation involving exposed skin areas, especially in the neck area of personnel in regular turnout gear. Emulsified solutions in water pose less of a hazard until such time as the water vaporizes upon release. Although the hazard is not reported in the literature, it is conjectured that exposure of well-sealed containers of emulsified sulfur solutions to excessive heat or fire may possibly cause generation of sufficient steam pressure to cause rupture of the container. The rupture may take place with violence if the container is of strong construction.

Hazardous Combustion Products: Normal combustion of pure sulfur is reported to produce highly toxic sulfur dioxide gas that may behave as if it is heavier than air. One authority reports that carbon bisulfide and highly toxic hydrogen sulfide gases may also be generated upon decomposition (both of these gases are themselves flammable).

EXPLOSION HAZARDS

Lower Explosive Limit: 35 mg/m^3 for sulfur dust in air.

Upper Explosive Limit: 1400 mg/m^3 for sulfur dust in air. These limits may vary considerably depending on the particle size and dispersion of sulfur dust in air.

Explosiveness: A cloud of sulfur dust in air may burn or explode if ignited by a flame, sufficiently hot surface, or spark. Contact of sulfur with certain other chemicals may result in an explosion. Accumulations of flammable hydrogen sulfide gas evolved from molten sulfur may explode if ignited in a confined area. See Behavior in Fire section directly above for a discussion of container rupture potential.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with solid sulfur or its aqueous solutions at normal temperatures; this may include rubber boots, gloves, face shields, splash-proof or dust-proof safety goggles, and other clothing including long pants and long sleeved shirts. Equipment should prevent any possibility of skin or eye contact with molten sulfur; this may include hard hats, face shields, splash-proof safety goggles, and heat-resistant gloves, boots without open tops, and other appropriate clothing. Fire retardant clothing is preferable when handling sulfur in any form. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high concentrations of combustion products in air. Note that the temperature of molten sulfur is sufficiently high that many synthetic plastic or rubber materials may melt or lose their strength. Protective equipment and clothing designed for chemical exposures may not be effective against the thermal hazard posed by direct contact with molten sulfur. Materials that may chemically be compatible with sulfur include neoprene and butyl rubber according to one authority.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent) is preferred for all emergency situations involving molten or burning sulfur. For other conditions in which exposures may occur, a NIOSH-approved dust or mist respirator appropriate for the airborne contaminant levels present may be adequate within the use limitations of these devices. Note that no protection may be necessary if the non-molten product has spilled in a non-fire situation and dusts or mists have not become airborne.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, nose, and/or throat; coughing; and various symptoms of ingestion for exposure to sulfur. Irritation of the eyes, nose, or throat; headache, dizziness, upset stomach, or other symptoms of hydrogen sulfide inhalation. Irritation of the eyes, nose, throat, and/or lungs; coughing, choking, difficult breathing, or other symptoms of sulfur dioxide exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's

FIRST AID (continued)

First Aid for Inhalation (continued): lungs or vomit.) If vomiting occurs naturally, have victim lean forward with head below hips to avoid aspiration of fluids into lungs.

First Aid for Skin and Eye Contact: If irritation occurs, flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing. Contact with molten sulfur may require treatment for thermal burns. Be advised that removal of solidified molten material from the skin or the area of the eyes may require professional medical assistance. Soap is not necessary when treating contact of the skin with molten sulfur.

First Aid for Ingestion: The majority of references recommend that large amounts of water should be administered immediately and that vomiting be induced if the victim is conscious. One suggests that a strong solution of baking soda (sodium bicarbonate) in water be used to reduce gastric acidity and prevent the formation of hydrogen sulfide in the gastrointestinal tract. Conversely, some references recommend that water be administered and that a physician be consulted before vomiting is induced. Use professional judgment if qualified, considering the amount of sulfur ingested, or consult a physician to determine which course of action to take. Do not make an unconscious person vomit. Get medical attention as soon as possible. If vomiting occurs naturally or is induced, have victim lean forward with head below hips to avoid aspiration of fluids into lungs.

FIRE RESPONSE

Extinguishing Materials: Water fog or spray; sand or dirt; special mixtures of dry chemical; carbon dioxide; saturated steam; an inert gas such as nitrogen; or foam (both regular and alcohol are mentioned by authorities). Some fires involving solid sulfur may possibly be extinguished by using additional sulfur to cover the burning product. Do not use a solid stream of water which may scatter the material. Note that water or foam may cause frothing; application into a tank of hot molten sulfur may result in boilover. A fire inside a tankcar may possibly be extinguished by closing the dome lid and letting the fire smother itself. One authority reports that water fog works better than water spray and that foam works better than water fog.

Extinguishing Techniques: Stay upwind. Avoid bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes or smoke is anticipated. Move container from fire area if no risk. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction if the container should rupture. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire in the case of emulsified solutions of sulfur. Post a fire watch for about four hours after the fire is controlled; sulfur fires may smolder and reignite. See the Unusual Hazards, Behavior in Fire, and Explosiveness sections of this Guide for additional information. Do not depend on installed transport tank pressure relief devices to limit pressures in tanks. These may easily become plugged with solid sulfur.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment compatible with the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Ground all equipment and transfer lines as necessary prior to use. Be advised that both the dry solid and molten liquid may generate static electricity. Liquid sulfur, especially when handled near or above its flash point in air, should be directed to the bottom of containers using a siphon breaking, electrically conductive internal fill pipe rather than being permitted to cascade down in free fall (to minimize generation of static electricity). Avoid handling solid sulfur at high velocities. Thoroughly melt all cargo before unloading of a vehicle is attempted if molten sulfur is being conveyed. Avoid heating sulfur above 300°F during transfer

SULFUR or MOLTEN SULFUR
Class 4.1 (Flammable Solid) or Class 9 (Miscellaneous Hazardous Material)

SPILL RESPONSES (continued)

General Information (continued): operations. Unload by gravity or pressure. Use regulated air or nitrogen pressure no more than that reasonably required for unloading. Be familiar with all hazards and characteristics of the product before initiating a cleanup effort. Be advised that solidified molten sulfur can be quite difficult to remove from pavement and other surfaces. There is some small possibility that discharge of a carbon dioxide fire extinguisher at the point of leakage of molten sulfur has the potential to solidify and stop the leak, at least temporarily. Other means of attempting to solidify the leaking product via cooling may also work. Whether or not the "plug" of solid will hold will depend on several factors including the amount of liquid remaining in the container and its temperature. It may become necessary to repeat the procedure several times until the leak can be patched or to ultimately abandon the effort. Use professional judgment in attempting this type of response. Molten sulfur temperatures can be quite high.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Sulfur and its solutions in water will not evolve significant amounts of hazardous airborne contaminants in many non-fire spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed. (Note: In order to pose a significant downwind inhalation hazard, molten sulfur that has discharged must contain and evolve significant quantities of toxic gases and/or toxic products of combustion must be generated from burning sulfur.)

CONSEQUENCE

Hazardous levels of various gases, dusts, and/or mists may possibly be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

EVACUATION . . . In the event of afire, it may become necessary to evacuate local and downwind areas as conditions warrant to prevent exposure and to allow smoke and fumes to dissipate. Burning sulfur may expose downwind areas to toxic gas and fume concentrations over considerable distances in some cases. So may spills of molten sulfur containing significant amounts of dissolved toxic gases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Extinguish fire if safe to do so. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow gases and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary. Note that the vapor pressure of the molten product and its vapor emission rate will decrease as it solidifies and cools in the ambient environment or if various means (see below) are used to accelerate its rate of cooling.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid sulfur with a plastic sheet or other compatible material to prevent airborne dust. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to dusts, mists, or gases in air may knock them down and/or accelerate their dispersal in the atmosphere. Application of water fog to the surface of molten sulfur may help control spreading, absorb heat, and help form a solid crust over the material that reduces toxic gas evolution. Wetting down of exposed sulfur powder may reduce generation of

TECHNIQUE (continued)

airborne dust. Note previous warnings about frothing and other hazards of applying water to very hot molten sulfur. Be advised that firefighting foams may have similar benefits and effects if applied to the surface of molten sulfur pools.

CONSEQUENCE

Water runoff may contain some amounts of sulfur and possibly other chemicals that may render soil toxic to plants.

MITIGATION

Contain contaminated water where deemed necessary and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments. Use caution when first applying water or foam to hot molten sulfur.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Solid sulfur, its emulsified solutions with water, and/or liquid molten sulfur may be contained by building dikes or barriers using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting (capable of withstanding the temperature of molten sulfur where necessary) covered with rocks and soil or sand, or via other appropriate methods. Let molten sulfur solidify before attempting cleanup. Consider use of a fine water fog or spray to accelerate solidification and cooling of molten sulfur pools, keeping in mind the potential frothing problem discussed earlier.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product, particularly liquids.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated pools of emulsified sulfur solutions or contaminated water runoff (where deemed necessary) may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. This response is unlikely to be appropriate for molten sulfur since cooling of the product may result in its solidification and subsequent plugging or clogging of transfer or storage equipment (unless specially designed for this purpose).

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged, develop leaks, or react with the sulfur.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of emulsified sulfur solutions or contaminated water runoff (where deemed necessary) may be controlled by absorbing the the liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and solid or solidified sulfur or its residues may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded, or alternatively, may react with the sulfur. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause sulfur dust to become airborne. Use of motorized equipment may possibly result in heating and ignition of sulfur dust under appropriate conditions.

MITIGATION

Select removal procedures that do not cause dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply caution if using any equipment that may result in heating and possible ignition of the sulfur. Consult qualified experts for advice where necessary.

TECHNIQUE

NEUTRALIZATION . . . Excessive amounts of sulfur may render soil toxic to certain types of plants. Where deemed necessary, application of an appropriate neutralization agent to contaminated soil may reduce adverse environmental impacts.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consult environmental officials about the need for neutralization.

SULFUR or MOLTEN SULFUR
Class 4.1 (Flammable Solid) or Class 9
(Miscellaneous Hazardous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Molten sulfur is expected to thicken, solidify, and sink to the bottom of water bodies, potentially releasing some hydrogen sulfide into the water. Powdered sulfur or emulsified sulfur solutions may result in particles of sulfur remaining dispersed in the water column. Some portions of powdered sulfur may float on the surface of the water for a time. All of these phenomena have been associated with adverse impacts on aquatic life with the degree of problems caused a function of conditions at the spill site and the nature of the aquatic system. They may also cause problems or hazards for users of the water.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination when the spilled material sinks in water.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water solids and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery. [Note: There may be occasions, especially when the water is very cold, that the molten liquid will form an amorphous "plastic" sulfur. If removal is not possible, let the sulfur solidify and apply a preferably inert and alkaline cover material such as limestone to the spill area until recovery procedures begin. This will reduce the possible formation and release of sulfuric acid into the water.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water containing suspended sulfur particles or dissolved contaminants may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Potentially suitable methods for suspended sulfur particle recovery include filtration and settling.

January 1988

SULFUR CHLORIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Sulfur chloride is an amber to yellowish red fuming liquid with an irritating, nauseating, pungent and penetrating odor. It is used in laboratories, for hardening wood, for gold extraction from ore, for purifying sugar juices, and for making vulcanized rubber or oils, military gases, insecticides, dyes, lube additives, and other products and chemicals. Its flash point of 245°F indicates that the product must be preheated before ignition may occur easily. Nevertheless, sulfur chloride may ignite organic matter spontaneously upon contact. Decomposition of the product due to excessive heat may result in rupture of containers. Contact with certain metals in the presence of moisture may generate flammable and potentially explosive hydrogen gas. The product weighs approximately 14.1 pounds per gallon.

Although stable in normal transportation, sulfur chloride reacts violently with water to produce heat, hydrochloric acid, sulfur, flammable hydrogen sulfide gas, sulfurous acid, sulfites, and other substances, and is highly reactive with a wide variety of other chemicals. It is also corrosive to many metals in the presence of moisture and to all bodily tissues. Products of combustion include toxic sulfur dioxide, chlorine, and hydrogen chloride gases.

If sulfur chloride is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard. Vapors and fumes may be heavier than air.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below.

Solubility in Other Chemicals: Soluble in alcohol, amyl acetate, benzene, carbon disulfide, and most organic solvents.

Specific Gravity (Liquid): 1.69 at 59.9°F (15.5°C)

Boiling Point: 280°F (137.8°C) at 1 atm; decomposes.

Melting Point: - 105°F (- 76.1°C) or - 112°F (- 80°C); reported values vary.

Freezing Point: See melting point

Molecular Weight: 135.03

Heat of Combustion: Unavailable

Vapor Pressure: 6.8 mm Hg (0.131 psia) at 68°F (20°C)

Flash Point: 245°F (118°C), closed cup; 266°F (130°C), open cup.

Autoignition Temperature: 453°F (233.9°C)

Burning Rate: Unavailable

Stability: Stable, but reacts with water.

Corrosiveness: Attacks metals in presence of moisture with evolution of hydrogen gas. Use materials compatible with hydrochloric acid.

Reactivity with Water: Decomposes violently to evolve heat and hydrochloric acid, sulfur, hydrogen sulfide, sulfurous acid, sulfites, etc. May ignite organic matter.

Reactivity with Other Chemicals: Reacts with alkalis, phosphorus trioxide, sodium peroxide, chromyl chloride, and a wide variety of other chemicals and substances.

IDENTIFICATION

Shipping Names: Sulfur chloride (USDOT); chloride of sulfur (USDOT); sulphur chlorides (IMO)

Synonyms and Tradenames: Sulfur monochloride; sulfur subchloride; disulfur dichloride; triosulfurous dichloride.

Chemical Formula: S_2Cl_2

Constituent Components(% each): May be up to 5% dissolved free sulfur in commercial material.

49 STCC: 49 323 80

UN/NA Designation: UN1828

IMO Designation: 8.0, corrosive

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Amber to yellowish red

Odor Characteristics: Penetrating, pungent, irritating, nauseating

Common Uses: Reagents; rubber and oil vulcanizing; purifying sugar juices; hardening of soft woods; gold extraction from ore; mfg. military poison gas, insecticide, pharmaceuticals, dyes, lube additives, and rubber substitutes; sulfur solvent.

SULFUR CHLORIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable, but 2 - 9 ppm in air is mildly irritating to eyes.
Unusual Hazards: Highly water-reactive and corrosive fuming liquid. Fumes are hazardous. Contact with metals may evolve hydrogen gas. May ignite organic matter upon contact. Hydrogen may be present in containers.
Short Term Exposure Limits (STEL): 3 ppm for 15 minutes. (ACGIH)
Time Weighted Average (TLV-TWA): 1 ppm over each 8 hours of a 40 hour work week. (ACGIH)
Conditions to Avoid: Heat, fire, and sparks; contact with water or incompatible substances; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive liquid that may produce large amounts of toxic, corrosive, and potentially flammable fumes or vapors, particularly if in contact with water.
Hazards of Skin or Eye Contact: Sulfur chloride may produce irritation or burns of the skin if not removed. Contact with the eyes may cause severe immediate damage which may result in permanent scarring.
Hazards of Inhalation: Exposure to sulfur chloride vapors or fumes may cause severe irritation, coughing, and tearing and burning of the eyes. High levels in air may cause severe breathing difficulty and symptoms of pulmonary edema or chemical pneumonia. All symptoms may be delayed in onset to various degrees.
Hazards of Ingestion: Ingestion of sulfur chloride may cause severe damage to the mouth and stomach.

FIRE HAZARDS

Lower Flammable Limit: Unavailable
Upper Flammable Limit: Unavailable
Behavior in Fire: *Will* burn but difficult to ignite. High temperatures cause decomposition to toxic chlorine gas and solid sulfur. Containers may rupture violently in fire. May generate large quantities of corrosive vapors or fumes upon release.
Hazardous Combustion Products: Toxic sulfur dioxide, chlorine, and/or hydrogen chloride gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable
Explosiveness: Very reactive. Containers may rupture in fire. Hydrogen gas evolved in reactions with some metals may explode if ignited in a confined area, as may hydrogen sulfide gas evolved in reactions with water. Vapors from hot sulfur chloride may explode if ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.
Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations {above 10 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted canister (10 ppm or less) or a chemical cartridge respirator with a full facepiece (10 ppm or less) within the use of limitations of these devices and with a canister or cartridge(s) for hydrogen chloride and sulfur dioxide.

1828

SULFUR CHLORIDE
Class 8 (Corrosive Material)

FIRST AID

Nonspecific symptoms: Irritations or burns; other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. (Note: If available, give milk, milk of magnesia, egg white, or olive oil after giving water. Give more water if vomiting occurs naturally.)

FIRE RESPONSE

Extinguishing Materials: Dry sand, carbon dioxide, dry chemical. Product reacts with water or foam but may consider using large amounts of water fog or water spray if large quantities of combustibles are involved.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. Note that addition of water may increase evolution of fumes from leaking product.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage; rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Note that contact with metals in the presence of water may evolve flammable hydrogen gas and that flammable hydrogen sulfide gas may be evolved in reactions with water. Use explosion-proof and spark-proof equipment where necessary. Take the reactivity of sulfur chloride into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Sulfur chloride spills may expose downwind areas to toxic concentrations over considerable distances if large amounts of heavier than air, corrosive vapors or fumes are evolved due to contact with water or moist air.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

SULFUR CHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to sulfur chloride vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point downwind of the spill and should not be allowed to contact pools of sulfur chloride, as this will increase fume evolution.

CONSEQUENCE

Water runoff may contain sulfur chloride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sulfur chloride may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained sulfur chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

SULFUR CHLORIDE
Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply this technique only to remove final traces of spilled product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

March 1995

SULFUR DIOXIDE
Poison Gas
(Division 2.3)

GENERAL INFORMATION

Sulfur dioxide is a colorless poison toxic gas that is shipped as a liquid under pressure and has a sharp odor like burning sulfur. It is used to make disinfectants, fumigants, glass, wine, processed foods, and a variety of other chemicals and products. Sulfur dioxide is fairly soluble in water. Liquid sulfur dioxide is heavier than water, and due to its boiling point of 14°F, may be expected to sink in water while simultaneously boiling and reacting to form a corrosive acid solution (reaction is not considered hazardous). The low boiling point also indicates that most spills can be expected to produce large amounts of gas and fumes. These are heavier than air, may expose downwind populations to toxic concentrations over considerable distances, and may persist in pits and depressions. Containers may rupture due to overpressurization if exposed to fire or excessive heat for sufficient time duration. The liquid weighs approximately 12.1 pounds per gallon at its boiling point temperature.

Sulfur dioxide forms sulfurous acid in reactions with water, and this acid may corrode aluminum and some other metals. Contact of sulfur dioxide with some powdered metals and with alkali metals such as sodium or potassium may result in fires or explosions, and the product is also reactive with a variety of other chemicals. Liquid sulfur dioxide may attack some forms of plastics, rubber and coatings, and is corrosive to bodily tissues.

If bulk container is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of 2500 feet. If cylinder is exposed to direct flame or fire becomes uncontrollable, evacuate for a radius of 1500 feet. If sulfur dioxide is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 10 g/100 g water at 68°F (20°C); decreases with increasing temperature.
Solubility in Other Chemicals: Soluble in acetic acid, ethyl alcohol, sulfuric acid, and organic solvents.
Specific Gravity (Liquid): 1.45 at 14°F (–10°C)
Boiling Point: 14°F (–10°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: –103.9°F (– 75.5°C)
Molecular Weight: 64.06
Heat of Combustion: Not flammable
Vapor Pressure: 3.27 atm. (48.1 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: Stable
Corrosiveness: Acidic reaction with water corrodes aluminum and several other metals. Liquid sulfur dioxide may attack some plastics, rubber, and coatings.
Reactivity with Water: Forms sulfurous acid in a nonhazardous reaction, then slowly oxidizes to sulfuric acid.
Reactivity with Other Chemicals: Reacts with cesium acetylene carbide, cesium monoxide, chlorates, chromium, ferrous oxide, lithium acetylene carbide, manganese, sodium, potassium, potassium acetylene carbide, potassium chlorate, sodium carbide, stannous oxide, halogens, acrolein, aluminum, chlorine trifluoride, and certain other substances.

IDENTIFICATION

Shipping Names: Sulfur dioxide (USDOT); sulphur dioxide (IMO)
Synonyms and Tradenames: Sulfurous acid anhydride; sulfur oxide; sulfurous anhydride; sulfurous oxide; fermenicide liquid.
Chemical Formula: SO_2
Constituent Components(% each): 99.90-99.98% pure
UN/NA Designation: UN1079
IMO Designation: 2.3, poison gas
Physical State as Shipped: Liquefied gas
Physical State as Released: Gas or liquid (boils at 14°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Sharp, pungent, like burning sulfur; may deaden sense of smell.
Common Uses: Mfg. sulfur compounds, disinfectants, fumigants, glass, wine, ice, proteins, vapor pressure thermometers; bleaching of beet sugar, flour, fruit, grain, oil, other products; tanning leather; insecticide; fungicide.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

SULFUR DIOXIDE
Poison Gas
(Division 2.3)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 3 ppm

Unusual Hazards: Extremely volatile substance with heavier than air gases and vapors. May expose downwind areas to toxic concentrations in air over considerable distances. Gas may persist in pits and depressions.

Short Term Exposure Limits(STEL): 5 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 2 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Heat or fire; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the toxic gas concentrations that may be present in the spill area and over considerable downwind distances. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with liquid sulfur dioxide may result in burns of the skin from the freezing effect of rapid evaporation. Contact with the eyes may cause corneal burns and opacification resulting in possible loss of vision.

Hazards of Inhalation: Sulfur dioxide gas is a severe irritant of the eyes, nose, throat and lungs at concentrations as low as 10 ppm in air. Higher levels may cause choking, coughing, difficult breathing, chest tightness, delayed chemical bronchopneumonia, and possibly death due to respiratory paralysis. Concentrations of 400-500 ppm are immediately dangerous to life; 50-100 ppm is maximum permissible level for 30-60 minute exposures.

Hazards of Ingestion: Although unlikely, burns of internal tissues would be expected if liquid sulfur dioxide were somehow ingested.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to overpressurization. Will generate large quantitites of toxic gases upon release.

Hazardous Combustion Products: Not flammable

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may rupture violently in fire due to overpressure. Contact with other substances such as sodium or potassium or powdered metals may result in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

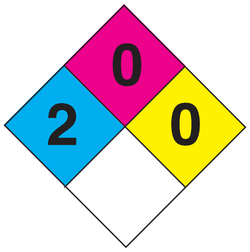
Protective Clothing Required: Equipment should prevent any possibility of eye contact with liquid sulfur dioxide and prevent the skin from becoming frozen from contact with the liquid or cold containers. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. For unknown or extremely high concentrations use chemically compatible, fully encapsulating suit.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 100 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with (SCBA) with full facepiece (or eqivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted sulfur dioxide canister or a sulfur dioxide cartridge respirator with a full facepiece within the use limitations of these devices.

1079

SULFUR DIOXIDE

Poison Gas
(Division 2.3)



FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately if eye contact has occurred or if skin irritation or burns persist after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water or milk immediately. Do not attempt to make the victim vomit, but if vomiting occurs naturally, give more water or milk. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but note that water applied to pools of liquid sulfur dioxide may increase gas evolution.

Extinguishing Techniques: Unusual toxic gas hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the toxic and extremely volatile nature of sulfur dioxide into account while planning the response. Note that gas may persist in pits and depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Sulfur dioxide spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to sulfur dioxide vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point downwind and should not be allowed to contact pools of liquid sulfur dioxide as this may increase gas evolution.

CONSEQUENCE

Water runoff may contain sulfur dioxide from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

SULFUR DIOXIDE
Poison Gas (Division 2.3)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Sulfur dioxide may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained sulfur dioxide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment.

MITIGATION

Use compatible equipment of proper pressure capacity.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels motorized graders and scrapers, loaders, bulldozers, and draglines. The response is best suited for removing final traces of a spill where necessary.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

SULFUR DIOXIDE

Poison Gas (Division 2.3)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECNNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

JULY, 1994

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

GENERAL INFORMATION

Sulfur trioxide is a thick, oily, colorless liquid with an acrid, irritating odor. It is not flammable, however, it is extremely corrosive. On contact with water, sulfur trioxide will react vigorously, generating substantial vapors composed predominately of sulfuric acid mist and un-reacted sulfur trioxide. While sulfur trioxide is not flammable, it is a powerful oxidizer and will react with most organic materials, including wood, and may cause ignition. Sulfur trioxide is extremely corrosive to living tissues and corrosive to, and may react violently with metals, generating heat and hydrogen gas. Reactions involving sulfur trioxide can proceed at an explosive rate.

When dealing with spills of sulfur trioxide, great care should be exercised in the use of water. Attempts to dilute large concentrations of sulfur trioxide with water may result in the development of substantial releases of vapors and acid mists. This can result in greatly expanding the threat of exposure well beyond the spill area. On dilution, depending on the amount of water involved, sulfur trioxide will form varying strengths of sulfuric acid.

In an accident situation, if sulfur trioxide is leaking and generating fumes, downwind evacuation of the spill area should be considered until properly equipped responders have assessed the nature of the threat. The spill assessment must account for the generation of large quantities of sulfuric acid mist, should sulfur trioxide combine with water.

Sulfur trioxide is used in the manufacture of oleum and sulfuric acid. It is also used as a sulfonating reagent in the manufacture of organic compounds and in the manufacture of non-ionic detergents.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Decomposes to 100% sulfuric acid.

Solubility in Other Chemicals: Soluble in sulfuric acid.

Specific Gravity (Liquid): 1.84 @ 37.8°C (100°F)

Vapor Density (Air=1): 2.8

Boiling Point: á -Sulfur trioxide 44.8°C (112.64°F); â-Sulfur trioxide 50°C (122°F), sublimes; ã -Sulfur trioxide 44.8°C (112.64°F).

Melting Point: á -Sulfur trioxide 16.83°C (62.3°F); (â-Sulfur trioxide 62.4°C (144.3°F); ã-Sulfur trioxide 16.8 (62.24°F).

Freezing Point: á -Sulfur trioxide 16.83°C (62.3°F), forms asbestos-like needles; (â -Sulfur trioxide 62.4°C (144.3°F), forms asbestos-like needles; ã -Sulfur trioxide 16.8 (62.24°F), forms ice-like mass.

Molecular Weight: 80.06

Heat of Combustion: Not flammable.

Vapor Pressure: @ 25°C (77°F) - á -Sulfur trioxide - 73 mmHg (â -Sulfur trioxide - 344 mmHg; ã -Sulfur trioxide - 433 mmHg.

Flash Point: Not flammable.

Autoignition Temperature: Not flammable.

Burning Rate: Not flammable.

Stability: á -Sulfur trioxide is the stable form, (â - and ã-forms tend to convert to á -Sulfur trioxide.

Corrosiveness: Highly corrosive to tissues, may produce hydrogen gas in contact with some metals.

Reactivity with Water: Decomposes violently. Reacts readily to form sulfuric acid, evolves heat. Evolves dense white fumes of sulfuric acid.

Reactivity with Other Chemicals: Oxidizing agent. Reacts readily with organic materials including wood. Heat of reaction sufficient to char or ignite wood.

IDENTIFICATION

Shipping Names: Sulfur trioxide

Synonyms and Tradenames: Sulfan, sulfuric anhydride, sulfan A ((â -sulfur trioxide, stabilized); sulfan B (ã - Sulfur trioxide, stabilized); sulfan C (not stabilized); CAS 7449-11-9.

Chemical Formula: $S0_3$

Constituent Components (% each): 99.8% sulfur trioxide.

UN/NA Designation: UN1829

IMO Designation: 8, corrosive.

Physical State as Shipped: Liquid.

Physical State as Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Acrid, burning.

Common Uses: Used in the sulfonation of organic compounds such as detergents.

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Not found.

Unusual Hazards: Highly reactive with water, liberating heat, to form dense cloud containing sulfuric acid and un-reacted sulfur trioxide. Highly corrosive to living tissues. Potent oxidizer. Reacts with most organic materials. May cause ignition of organic fuels including wood. May generate flammable hydrogen gas through the corrosion of metals.

Short Term Exposure Limits (STEL): None established.

Time Weighted Average (TLV-TWA): None established.

Conditions to Avoid: Contact with water or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Extremely corrosive to (issues. Contact with vapors may result in severe burns to skin and respiratory system. Acts quickly to produce damage. Atmospheres of 1 ppm (3 mg/m^3) are sufficient to cause coughing, choking and severe discomfort. Reactions with water may result in the evolution of a substantial acid vapor cloud increasing the threat of downwind exposure.

Hazards of Skin and Eye Contact: Eye exposure can result in severe burns to eye tissue. Extent and duration of exposure will determine the severity of the injury which could result in permanent blindness. Severe acid burns to the skin are likely to result from sulfur trioxide exposures. Burns may be deep, penetrating below the skin depending on the nature of the exposure.

Hazards of Inhalation: Severe respiratory irritant. Corrosive to respiratory mucous membranes. Symptoms include cough and wheezing. May progress to acute pulmonary edema and chemical pneumonia. Inhalation exposures may be fatal depending on the concentration and duration of exposure. Burns may progress even after removal from exposures due to the continued action of sulfuric acid residues.

Hazards of Ingestion: Highly corrosive to tissues in the mouth, esophagus, and stomach. May result in severe burns to the exposed tissues.

FIRE HAZARDS

Lower Flammable Limit: Not flammable.

Upper Flammable Limit: Not flammable.

Behavior in Fire: May form hydrogen gas in contact with most metals. Will not burn but may ignite organic materials including wood. Reacts violently with water to form dense, white, acid mist cloud.

Hazardous Combustion Products: Not flammable, products will relate to fuel involved.

EXPLOSION HAZARDS

Explosiveness: May evolve hydrogen gas in contact with most metals. Usually stabilized to inhibit crystallization. Reactions with water will evolve substantial amounts of sulfuric acid mist. Reaction will be intense and violent.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: *Full* acid suit or comparable protective equipment is necessary when dealing with sulfur trioxide releases. Equipment should protect from all direct contact with sulfur trioxide. Suitable materials of construction may include butyl rubber, neoprene, nitrite rubber, CPE, Viton, and polyvinyl chloride.

Respiratory Protection: *Full* respiratory protection. Positive pressure, self contained breathing apparatus or supplied air systems with full facepiece (or equivalent) are recommended for handling spills and fires involving sulfur trioxide.

1829

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Severe burns to any tissues involved depending on the level of exposure. Eye contact may result in permanent damage or blindness. Severe corrosion of respiratory tissues with symptoms including coughing, wheezing, choking, pulmonary edema, and chemical pneumonia. Symptoms may progress after removal from exposure due to residual contamination. Pulmonary symptoms may continue to develop after removal from exposure and victims should be observed for development/progression of pulmonary edema and delayed chemical pneumonia.

First Aid For Inhalation: Remove victim to fresh air. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure, resulting in increased respiratory distress with time. Symptoms of pulmonary edema and chemical pneumonia may continue to develop for some time (1 - 2 days) after exposure. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Severe exposures may result in permanent eye damage or blindness. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance immediately.

First Aid for Ingestion: *Do* not induce vomiting. If victim is conscious, administer large quantities of water or milk. Never give anything by mouth to an unconscious person. Seek medical assistance immediately.

FIRE RESPONSE

Extinguishing Materials: Not flammable. Materials should be appropriate to the fuel involved.

Extinguishing Techniques: The use of water to control fire in the vicinity of spilled sulfur trioxide should be weighed against the threat of vapor generation from the reaction of sulfur trioxide and water. Introducing water into containers containing sulfur trioxide should be avoided. Spilled sulfur trioxide should be protected from contact with water runoff to minimize the generation of acid mists.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to spill area. Avoid contact with spilled material. Prohibit unprotected personnel from entering spill area. Seek expert assistance. Protect sewers and waterways from spilled sulfur trioxide or contaminated runoff. Notify authorities, downstream of spill, of the potential for contamination. Be alert to conditions which may result in the mixing of water with spilled sulfur trioxide. Protect spills from contact with water, if possible, to avoid excess acid mist generation. Keep in mind that sulfur trioxide reacts with water to form sulfuric acid. Choose equipment which is compatible with sulfur trioxide. Contact with metals can result in the generation of hydrogen gas.

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

AIR SPILL

TECHNIQUE

EVACUATION... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Sulfur trioxide, when reacting with water, will form dense acid mists. Releases may expose downwind areas to toxic concentrations over considerable distances depending on the rate of mist generation.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Seek expert assistance. Stop leak if without risk and if proper equipment and trained personnel are available. Allow vapors and gas to dissipate completely before reentering spill area without special protective gear.

TECHNIQUE

WATER FOG OR SPRAY... Water fog may be used to control vapors and mists from sulfur trioxide spills. Sulfur trioxide will likely react with water to form sulfuric acid.

CONSEQUENCE

Water fog or spray for vapor control will react with vapors and mists to form sulfuric acid. Water fog or runoff from sprays added to spilled sulfur trioxide liquids will result in the generation of significant quantities of acid mist. Water runoff may contain levels of sulfuric acid from contact with sulfur trioxide. Water will become acidic and the pH will depend on the levels of acid generated. High levels of sulfuric acid in solution will pose a significant hazard. Refer to the **Sulfuric acid**, *Emergency Action Guide* for further information.

MITIGATION

Do not expose standing pools of sulfur trioxide to water. Do not spray water in containers of sulfur trioxide. Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may contact spilled sulfur trioxide and take steps to prevent such contact. Refer to the **Sulfuric acid, *Emergency Action Guide*** for further information.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Spills of sulfur trioxide on land may be contained by building dikes or barriers using soil, sand, or other materials. Where sulfur trioxide is likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Sulfur trioxide may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may react with contained sulfur trioxide. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking product.

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Sulfur trioxide may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination. Excavations will expose moist soil to sulfur trioxide and may increase the rate of vapor generation. Excavations exposing groundwater will promote the generation of large amounts of acid mist.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may cause increased vapor generation. Where possible, line containment areas with suitable, impervious material. Do not excavate deep enough to risk exposing product to groundwater.

TECHNIQUE

PUMPING/VACUUM SUCTION... Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Care should be taken to use equipment which is compatible with sulfur trioxide as it may react with metals to generate flammable hydrogen gas. Equipment should be dry to avoid contact with water.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed. Reaction with metals may generate hydrogen gas. Water contained in equipment may increase the generation of mist or vapor.

MITIGATION

Use equipment constructed of compatible materials. Insure equipment is free from water. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION... Spilled sulfur trioxide can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with sulfur trioxide and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

WATER SPILL

Sulfur trioxide will react in water to form sulfuric acid. Refer to the **Sulfuric acid, *Emergency Action Guide*** for further information.

TECHNIQUE

STOP USE... Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

SULFUR TRIOXIDE, INHIBITED
Class 8 (Corrosive Material)

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION... Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

September 2003

SULFURIC ACID

Class 8 (Corrosive Material)

GENERAL INFORMATION

Sulfuric acid is a colorless to dark brown oily liquid that is odorless when cool but may evolve choking vapors when hot. Commercial preparations may contain as much as 93 - 98% sulfuric acid in water. The product is fully soluble in water and is used to make fertilizers, explosives, artificial fibers, dyes, pharmaceuticals, detergents, glue, paint, paper and a wide variety of other chemicals and products. It is not flammable but is a strong oxidizer and highly reactive substance that may char wood upon contact and occasionally ignite combustible materials. Contact with most metals generates flammable and potentially explosive hydrogen gas. The product weighs 13 - 15.3 pounds per gallon depending on concentration.

Concentrated sulfuric acid reacts violently with water with the evolution of heat. Never add water to acid, spattering may occur. The product is highly corrosive to many metals, is also highly corrosive to bodily tissues, and is reactive with a wide variety of chemicals and substances, possibly causing fires or explosions. Toxic vapors are generated when sulfuric acid is heated to decomposition.

Initial downwind wind evacuation should be considered on a case by case basis if the product is leaking and large amounts of fumes are generated. Fumes and vapors may be heavier than air. If container of sulfuric acid is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile in all directions for protection from flying debris if the container should rupture violently. (Note: "Fuming sulfuric acid" is a term used for sulfuric acid with considerable amounts of dissolved sulfur trioxide. This latter product is also commonly known as "oleum" and is addressed by a separate guide in this series.)

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions

Solubility in Other Chemicals: Decomposes in alcohol.

Specific Gravity (Liquid): 1.56 - 1.84 at 68°F (20°C); 1.84 for 98% acid

Vapor Density: 3.4

Boiling Point: 644°F (340°C) for 98% acid at 1 atm

Melting Point: 37.4°F (3°C) for 98% acid

Freezing Point: 50.6°F (10.4°C) for 100% acid

Molecular Weight: 98.08

Heat of Combustion: Not flammable

Evaporation Rate (butyl acetate=1): <1

Vapor Pressure: .001 mmHg at 68°F (20°C)

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Flammable Limits: Not flammable

Stability: Stable

Polymerization Potential: Will not occur

pH: Very acidic. Varies between .3 to 2.1, depending on percent solution.

Corrosiveness: Highly corrosive acid, may generate hydrogen gas in contact with metals.

Reactivity with Water: Reacts violently with evolution of heat. Hygroscopic liquid.

Reactivity and Incompatibility: Reacts with organic materials and compounds, carbides, chlorates, fulminates, nitrates, picrates, metals, sodium, sodium carbonate, potassium permanganate, phosphorus, saltpeter, lithium silicide, mercuric nitride, nitrotoluene, acetone cyanohydrin, acetone and nitric acid and numerous other chemicals.

IDENTIFICATION

Shipping Name(s): Sulfuric acid (USDOT); Sulphuric acid (IMO)

Synonyms and Tradenames: Battery acid; Chamber acid; Fertilizer acid; Oil of vitriol; Dipping acid; Dithionic acid; BOV; Brown oil

CAS Registry No.: 7664-93-9

Chemical Formula: H_2S0_4

Constituent Components (% each): 5 - 100% acid with any remainder mostly water.

UN/NA Designation: UN1830 (> 51% sulfuric acid); UN2796 (<51% sulfuric acid)

IMO Designation: 8, Corrosive substances

RTECS Number: WS5600000

NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 2 (Reactivity): Reacts with water

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless (pure) to dark brown

Odor Characteristics: Odorless unless hot, then choking.

Reportable Quantity: See appendix I

Common Uses: Synthetic fertilizers, nitrate explosives, artificial fibers, dyes, pharmaceuticals, detergents, glue, paint, paper, and numerous chemicals; dehydrating agent; electrolyte in batteries; petroleum refineries; etching; making iron steel; various other uses.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

*Also 2796

SULFURIC ACID

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive oxidizing mineral acid. May char and possibly ignite combustible materials. Reacts violently with water when concentrated. Contact with metals may generate hydrogen gas.

Short Term Exposure Limit (STEL): 3 mg/m^3

Time Weighted Average (TLV-TWA): 1 mg/m^3 over each 8 hours of a 40 hour work week (ACGIH)

IDLH: 15 mg/m^3

Conditions to Avoid: Heat, fire, or sparks where hydrogen may be present; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Highly corrosive to bodily tissues by all routes of exposure.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with liquid sulfuric acid may result in severe, deep and painful burns. Extensive burns may result in shock and collapse.

Hazards of Inhalation: Fumes and mists of sulfuric acid may cause irritation of the eyes, nose, throat and upper respiratory tract as well as teeth erosion and soreness of the mouth. High concentrations in air may cause sneezing, coughing, difficult breathing and laryngeal, tracheobronchial and pulmonary edema with possibly severe consequences.

Hazards of Ingestion: Ingestion of concentrated sulfuric acid may result in severe burns of the mouth and throat, perforation of the esophagus or stomach, staining and erosion of teeth, nausea and vomiting of blood and eroded tissue and possibly death.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: May generate large quantities of corrosive fumes or vapors upon release.

Hazardous Combustion Products: Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

EXPLOSION HAZARDS

Explosive Potential: Contact with most metals produces hydrogen gas that may explode if ignited in confined spaces. Contact with certain other chemicals may result in formation of explosive mixtures.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include butyl rubber, neoprene, nitrile rubber, chlorinated polyethylene, polyvinyl chloride, styrene-butadiene rubber, Viton® and nitrile-butadiene rubber for concentrated (more than 70%) acid as well as less concentrated solutions.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations (above 15 mg/m^3), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with chin-style or front or back mounted acid gas canister and high efficiency particulate filter or a high efficiency particulate filter respirator with a full facepiece.

1830 *

*Also 2796

SULFURIC ACID

Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Irritation or burns of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda.

First Aid for Eye Contact: Flush eyes immediately with water for at least 30 minutes, occasionally lifting the eyelids. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: As suitable for surrounding fire, but note that concentrated sulfuric acid reacts violently with water. Water (if used) should be applied in flooding quantities as fog or spray.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire-exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Sulfuric acid is a highly corrosive liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Prevent liquid from entering sewers and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that sulfuric acid is highly corrosive and reactive. Contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Underflow dams are not an effective means to dike material since it is soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust.

SULFURIC ACID
Class 8 (Corrosive Material)

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Sulfuric acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly if the acid is not fuming or small quantities have spilled.

CONSEQUENCE

Hazardous levels of sulfuric acid in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases. Fumes may be heavier than air.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Water should be applied at a point upwind of the spill and should not be allowed to contact pools of sulfuric acid.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of sulfuric acid from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Sulfuric acid may be confined by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Confined sulfuric acid may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

SULFURIC ACID

Class 8 (Corrosive Material)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

SULFURIC ACID

Class 8 (Corrosive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

September 2006

SULFURIC ACID, SPENT†

Class 8 (Corrosive Material)

†Also see sulfuric acid guide

GENERAL INFORMATION

Spent sulfuric acid is a colorless to dark brown or black liquid that is the residue resulting from the use of sulfuric acid in leaching metal ores, pickling steel, acid dipping or electroplating metals, treating wool, making various chemicals or processing petroleum products. Consequently, such liquids may contain a considerable amount of sulfuric acid but might also contain various amounts of metal salts, organic substances such as fatty acids, or petroleum sulfonates. Since the specific composition of the spent acid varies, this guide is an attempt to provide an approximate set of response recommendations that should be adequate in most cases but may require interpretation and modification in the field based on professional judgment. It is strongly suggested that the shipper of the spent acid be contacted to determine the specific composition and any unusual or unexpected hazards of the substance. Other guides in this series or additional data sources may then be used to obtain further data on components. The guide for sulfuric acid in this series is especially relevant.

In many cases, spent sulfuric acid may not be combustible, however, some spent sulfuric acid contains combustible materials and so this should be considered. Note that the acid may be reactive with a variety of substances, and that contact with many metals may generate flammable and potentially explosive hydrogen gas. Concentrated sulfuric acid may react violently with water, and may char and occasionally ignite combustible materials. Any spilled material should be considered highly corrosive and reactive until proven otherwise.

If spent sulfuric acid is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions for liquids and at least 75 feet (25 meters) for solid. For larger spills, increase in the downwind direction as conditions warrant. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Expect that much will dissolve in water, some may not.
Solubility in Other Chemicals: Varies with composition
Specific Gravity (Liquid): Est. 1.39 at 68°F (20°C), may vary
Vapor Density: Heavier than air
Boiling Point: Est. >212°F (100°C), varies greatly
Melting Point: Varies
Freezing Point: Varies
Molecular Weight: 98.08 for sulfuric acid (H_2S0_4)
Heat of Combustion: Unknown, may or may not be combustible.
Evaporation Rate: Slow for acid component
Vapor. Pressure: 0.001 mmHg (sulfuric acid)
Flash Point: Acid component is not flammable but some products report >200°F (93°C) open cup
Autoignition Temperature: Acid component is not flammable but some products report 450 – 853°F (232 – 456°C)
Burning Rate: Unknown
Flammable (Explosive) Limits: 1% (LEL) – 8% (UEL)
Stability: Stable
Polymerization Potential: Should not occur
pH: Expected to be around 1
Corrosiveness: Strong acid may be highly corrosive to many metals, plastics, and rubber materials.
Reactivity with Water: Depends on particular product. Stronger acids may react violently with water.
Reactivity with Other Chemicals: Varies with composition. Sulfuric acid reacts with a wide variety of organic compounds, combustible materials, metals, oxidizable materials, bases, nitrates, chlorates, carbides, sulfides, cyanides, fulminates, picrates and other chemicals. Some reactions may be violent or explosive.

IDENTIFICATION

Shipping Names: Sulfuric acid, spent (USDOT); Sulphuric acid, spent (IMO)
Synonyms and Tradenames: Sulphuric acid, spent
CAS Registry No.: 7664-93-9 (sulfuric acid)
Chemical Formula: H_2S0_4 for sulfuric acid
Constituent Components (% each): Composition may vary widely
UN/NA Designation: UN1832
IMO Designation: 8, corrosive substances
RTECS Number: WS5600000 (sulfuric acid)
NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 2 (Instability): Water reactive. Note: Flammability rating is for sulfuric acid, but some spent products will contain components that may raise its flammability rating.
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless to dark brown or black
Odor Characteristics: Varies, may be odorless
Reportable Quantity: See Appendix I
Common Uses: Results from leaching of metal ores, pickling steel, acid dipping or electroplating metals, treating wool, making various chemicals, or processing petroleum products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

SULFURIC ACID, SPENT

Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unknown, one source reports >1 mg/m^3

Unusual Hazards: Composition uncertain; may contain toxic substances. May or may not be combustible. Contact with metals may generate hydrogen gas. Strong acid may be highly corrosive and reactive. Some products may contain carcinogens.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 1 mg/m^3 (sulfuric acid) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 15 mg/m^3 (sulfuric acid)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials and water; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Concentrated sulfuric acid is highly corrosive to bodily tissues by all routes of exposure. Spent acid may or may not be less corrosive and may have additional toxic effects due to other constituents. Data presented here are primarily for pure concentrated acids.

Hazards of Skin or Eye Contact: Contact of the skin or eyes with liquid sulfuric acid, or its concentrated fumes in air, may result in severe, deep, and painful burns and blistering. Extensive burns may result in shock and collapse. May cause corneal opacity.

Hazards of Inhalation: Fumes and mists of sulfuric acid may cause irritation of the eyes, nose, throat, and upper respiratory tract, as well as erosion of the teeth and soreness of the mouth. High concentrations in air may cause sneezing, coughing, difficult breathing, and laryngeal, tracheobronchial and pulmonary edema with possibly severe consequences. Victims should be followed for delayed appearance of pulmonary edema and chemical pneumonitis.

Hazards of Ingestion: Ingestion of concentrated sulfuric acid may result in severe burns of the mouth and throat, perforation of the esophagus or stomach, staining and erosion of teeth, nausea and vomiting of blood and eroded tissue and possibly death.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Varies by product and may not be flammable, some reported ranges: 1%

Upper Flammable (Explosive) Limit: Varies by product and may not be flammable, some reported ranges: 8%

Behavior in Fire: May or may not burn. There is some remote potential for containers to rupture in fire. May generate corrosive or toxic fumes upon release.

Hazardous Combustion Products: Depends largely on particular product. May include carbon dioxide, carbon monoxide, nitrogen and sulfur oxides, particulate matter, volatile organic compounds and other toxic and corrosive fumes.

EXPLOSION HAZARDS

Explosiveness: Contact with various other chemicals and materials may result in the formation of explosive mixtures or violent reactions. Vapors of any flammable components or hydrogen gas generated by contact with metals may explode if ignited in confined spaces. There is some remote potential for containers to rupture in fires.

1832

SULFURIC ACID, SPENT

Class 8 (Corrosive Material)

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials for sulfuric acid (more than 70%) may include butyl rubber, neoprene, nitrile rubber, latex, natural rubber, chlorinated polyethylene, polyvinyl chloride, styrene-butadiene rubber, Viton®, and nitrile-butadiene rubber. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 1; Tychem® QC; Tychem® CPF 2; Tychem® SL; Tychem® CPF 3; Tychem® CPF 4; Tychem® BR; Tychem® LV; Tychem® Responder®; Tychem® Responder® CSM; Tychem® TK; Tychem® F; Tychem® Reflector®; Tychem® CPE; Tychem® ThermoPro; Trellchem HPS® suits; CPF3® suits; Barricade® coated suits; butyl rubber (gloves, suits, boots); polyethylene (gloves, suits, boots); Teflon® (gloves, suits, boots); Saranex® coated suits; Viton 890® gloves; Viton® 892 gloves; Neop. Chloroflex 723 gloves; Chem Master gloves; Butyl 878 gloves; Butyl 874R gloves; Chloroflex II gloves; Neoprene 6780 gloves; 4H® and Silver Shield® brand gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Viton® (gloves, suits).

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 15 mg/m^3): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 15 mg/m^3): any supplied-air respirator operated in a continuous-flow mode (eye protection needed); any powered air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter (eye protection needed); any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with an N100, R100, or P100 filter; any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter; any self-contained breathing apparatus with a full facepiece; or any supplied-air respirator with a full facepiece.

FIRST AID

Nonspecific Symptoms: Irritation or burns of bodily tissues; any other unusual symptoms that may be related to chemical exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid using mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: In case of skin contact do not delay, remove contaminated clothing immediately and wash skin with plenty of cold water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 20 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire, but note that concentrated sulfuric acid may react violently with water. Water (if used) should be applied in flooding quantities as fog or spray. For small fires, dry chemical or carbon dioxide.

Extinguishing Techniques: Possible corrosive vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SULFURIC ACID, SPENT
Class 8 (Corrosive Material)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the corrosiveness and reactivity of the product with many common metals when deciding on the appropriate response and equipment. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Do not use combustible materials, such as sawdust. Consult a qualified specialist on neutralization techniques. Take into account while planning the response that spent acid may be highly corrosive and reactive and that there is some chance that the substance may be combustible. Contact with metals may produce flammable and potentially explosive hydrogen gas. Use explosion-proof and spark-proof equipment where necessary. Vapors may be heavier than air and may persist for a time in low areas.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . Spent sulfuric acid may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill by checking for pH until the spilled product is removed.

CONSEQUENCE

Hazardous levels of chemical in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to spent sulfuric acid vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind and do not allow it to contact pools of spent sulfuric acid if it is suspected that this may cause a violent reaction.

CONSEQUENCE

Water runoff may contain chemicals from contact with vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid spent sulfuric acid may eventually slow the release of vapors or fumes into the atmosphere.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

SULFURIC ACID, SPENT

Class 8 (Corrosive Material)

TECHNIQUE

DILUTION . . . The rapid addition of flooding quantities of water to liquid spent sulfuric acid may eventually slow the release of vapors or fumes into the atmosphere. This response has special risks and is better suited to smaller spills.

CONSEQUENCE

Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spent sulfuric acid may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained spent sulfuric acid may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

SULFURIC ACID, SPENT

Class 8 (Corrosive Material)

TECHNIQUE

NEUTRALIZATION. . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES. . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. (Note: Additional treatment methods may be necessary for non-acidic components of spent sulfuric acid.)

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Proceed with caution. Consult shipper as to constituents of spilled material. Consult qualified experts for safe neutralizing and treatment techniques.

September 1992

TEREPHTHALIC ACID
Non-Regulated

GENERAL INFORMATION

Terephthalic acid is not designated as a hazardous material in transportation but nevertheless has some potential to cause injury and/or environmental pollution if improperly handled. It is consistently ranked among the top 25 chemicals produced in the United States and may therefore be encountered comparatively frequently in transportation or other accidents resulting in a chemical discharge.

Terephthalic acid is usually shipped in the form of solid white or off-white crystals or powders. It may be odorless or have a slight odor resembling acetic acid. It is used for making various plastic products and other chemicals, as an additive in poultry food, in analytical chemistry, and as a reagent for alkali in wool. The acid is practically insoluble in water and heavier, so may be expected to sink and dissolve at an extremely low rate. Even small amounts dissolved in water are reported to greatly lower the pH of the resulting solution. The solid acid is generally reported to sublime as it is heated and is therefore expected to vaporize before melting. Its flash point of 500°F indicates that substantial heating is necessary before its vapors can easily be ignited. Of concern, however, is that the dust of terephthalic acid can form combustible or explosive mixtures with air that may be ignited by a strong spark or other source of ignition. The product weighs approximately 93.6 pounds per cubic foot as a solid. Its vapor pressure at room temperatures is extremely low.

Terephthalic acid does not react with water or other common materials and is stable in normal transportation. It is specifically reported to react violently or explosively, or else ignite, in reactions with strong oxidizing agents, to react vigorously with strong bases, and to react with active metals such aluminum or zinc in a manner that evolves flammable and potentially explosive hydrogen gas. It is also probable that terephthalic acid may attack some forms of plastics, rubber, and coatings. Toxicity of the product is low by all routes of exposure. Products of combustion may include toxic substances.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; 0.002 g/100 g water at 77°F (25°C).

Solubility in Other Chemicals: Soluble in alkalies or dimethyl sulfoxide; slightly soluble in alcohol, formic acid, or sulfuric acid.

Specific Gravity (Solid): 1.5 at 68°F (20°C)

Boiling Point: Sublimes at temperatures above 572°F (300°C) according to some authorities; others report sublimation occurs at 755°F (402°C). (Note: A solid material that sublimes is one that vaporizes as its temperature is increased without ever melting to become a liquid. Its hot vapor in air will condense to a solid rather than a liquid as its temperature decreases.)

Melting Point: Two authorities, somewhat inconsistently, provide a melting point of 801°F (427°C); others repeat the information given above regarding sublimation of the material.

Freezing Point: See melting point

Molecular Weight: 166.13

Heat of Combustion: - 4,397 cal/g as standard net heat of combustion

Vapor Pressure: Less than 0.01 mm Hg (0.000193 psia) at 68°F (20°C); 0.5 mm Hg (0.0097 psia) at 248°F (120°C).

Flash Point: 500°F (260°C), open-cup

Autoignition Temperature: Most sources report 925°F (496°C); one notes that the minimum ignition temperature for a terephthalic acid dust cloud is 1250°F (678°C).

Burning Rate: Not available

Stability: Stable

Corrosiveness: No specific data are available but corrosivity to some metals may be presumed in the presence of moisture or water. A saturated solution (0.002%) of terephthalic acid in water has been calculated to have a pH of 2.16. See "Reactivity with Other Chemicals" below. It is probable but unconfirmed that the substance may attack some forms of plastics, rubber, or coatings.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Terephthalic acid is specifically reported to react violently or explosively with strong oxidizing agents and/or to increase the risk of fire; to react vigorously with strong bases; and to react with active metals such as aluminum or zinc to evolve flammable and potentially explosive hydrogen gas.

IDENTIFICATION

Shipping Names: No particular name is standard but "chemicals, n.e.c." The shipper may or may not provide the specific chemical name of the product.

Synonyms and Tradenames: Benzene-p-dicarboxylic acid; p-benzenedicarboxylicacid; 1,4-benzenedicarboxylic acid; p-dicarboxybenzene; p-phthalic acid; TPA; and various tradenames.

Chemical Formula: $C_6H_4(COOH)_2$ or HO-CO-C_6H_4-CO-OH; terephthalic consists of a benzene ring with two attached -COOH groups.

Constituent Components (% each): Apparently available in various grades of 97% or more purity. One particular product is described as containing 98.5% terephthalic acid, a maximum of 0.5% water, 25 ppm 4-formylbenzoic acid, and 10 ppm metals.

28 STCC: 28 186 71 (for both terephthalic acid and terephthalic anhydride; this guide only addresses the acid).

UM/NA Designation: Not established

IMO Designation: Not established

Physical State As Shipped: Solid crystals or powder

Physical State As Released: Solid crystals or powder

Color of the Shipped Material: White or off-white

Odor Characteristics: None to slight acetic acid odor

Common Uses: Making polyester (i.e., plastic) fibers, films, sheets, and bottle resins; making other chemicals; additive in poultry food; reagent for alkali in wool; used in analytical chemistry.

TEREPHTHALIC ACID
Non-Regulated

POTENTIAL HAZARDS
GENERAL HAZARDS

Threshold Odor Concentration: Not available

Unusual Hazards: Ignition of a sufficient concentration of dust in air may result in fire or explosion. The solid product sublimes as it is heated. Very small amounts of the product in water are reported to substantially lower the pH of the water and form a fairly strong acid. Reactions of terephthalic acid with active metals may evolve flammable and potentially explosive hydrogen gas.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limits: 10 mg/m^3 (total dust) over each 8 hours of a 40 hour work week (ACGIH TLV, 1990-91); 15 mg/m^3 (as total dust) and 5 mg/m^3 (as respirable fraction) under similar circumstances (OSHA PEL, 1989); all as exposure limits for "nuisance dusts".

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; buildup of static electricity where dust in air may form flammable or explosive mixtures.

HEALTH HAZARDS

Public Health Hazards: The health hazards of terephthalic acid have not been thoroughly investigated according to one authority. Hazards attributable to the substance under normal conditions appear to be comparatively minimal in the case of episodic spills into the environment, but it is always prudent to minimize unnecessary exposures to chemical substances.

Hazards of Skin or Eye Contact: A major manufacturer of terephthalic acid reports that contact of the solid product with the eyes is not expected to cause significant irritation, and this appears accurate if the substance is promptly removed. Standard tests involving rabbits caused only mild eye irritation; causation of moderate irritation required continuous contact for 24 hours. The product did not cause skin irritation in tests with animals, and according to the same manufacturer is not expected to cause significant irritation of human skin.

Hazards of Inhalation: A major manufacturer of terephthalic acid reports that its dust is not expected to cause toxic effects via inhalation under normal conditions of use.

Hazards of Ingestion: The single dose oral toxicity of terephthalic acid is very low with the LD^{50} for rats, the dosage causing death of 50% of the animals in laboratory experiments, being in excess of 15.4 g/kg of body weight and that for the mouse being 6.4 mg/kg on the same basis. Nevertheless, a government authority reports that solutions (presumably in water) may produce irritation to the mouth and throat and that large amounts may cause gastric pain, nausea, and vomiting.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: *Will* burn but requires heating to its flash point of 500°F, or dispersal in air as a dust cloud, and then encounter with a suitable source of ignition. One government authority cautions that contact of the burning material with water or foam may cause frothing.

Hazardous Combustion Products: Not well-defined; reported to include carbon monoxide, carbon dioxide, and possibly other toxic constituents. One authority reports that terephthalic acid emits acrid smoke and irritating fumes when heated to decomposition.

EXPLOSION HAZARDS

Lower Explosive Limit: 50 grams of dust per cubic meter of air

Upper Explosive Limit: Unavailable

Explosiveness: Terephthalic acid dust can form explosive mixtures with air. The lower explosive limit (LEL) concentration shown above is equivalent to 0.0031 pounds of the acid dust per cubic foot of air. The minimum autoignition temperature for a cloud of dust is reported to be 1250°F (678°), but it must be cautioned that a high-voltage spark, even one generated from static electricity, may be adequate for ignition.

TEREPHTHALIC ACID
Non-Regulated

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include gloves, dust goggles (if high dust concentrations are present in air), and other appropriate clothing as required. No specific guidance is available with respect to compatible materials. One government authority states the belief that most materials commonly used in protective clothing will probably be adequate, then recommends that the chemical manufacturer or supplier be asked for specific advice.

Respiratory Protection: For fire fighting, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For high concentrations of dust in air, an approved respirator that will prevent dust inhalation.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, and upper respiratory tract; coughing; various symptoms of ingestion.

First Aid for Inhalation: If necessary, remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes with water for at least 15 minutes, occasionally lifting the eyelids. When deemed necessary, remove contaminated clothing, gently blot or brush away excess chemical, and wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: If conscious, have victim rinse mouth thoroughly and then drink large glass of water. Do not induce vomiting. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into the lungs; have victim rinse mouth again and repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Water spray, dry chemical, carbon dioxide, alcohol foam. Be advised that water or foam may cause frothing. Water should be applied gently as a fog or mist. Solid streams of water may be ineffective.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Protect sewers and waterways from contamination. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use spark-proof and explosion-proof tools and equipment where necessary. Precautionary measures against static electricity discharges, including thorough electrical interconnecting, grounding of equipment, and conveyance under inert gas are advised where terephthalic acid dust is present.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Terephthalic acid spills do not appear likely or capable of generating significant amounts of hazardous airborne contaminants in most outdoor spill situations. It may be advisable to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Irritating levels of terephthalic dust in air may be found in the local spill area and immediately downwind in some few cases.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind as necessary.

TEREPHTHALIC ACID
Non-Regulated

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid terephthalic acid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Where deemed necessary, water fog or spray applied to terephthalic dusts or vapors in air may knockdown dust and accelerate dispersal of vapors in the atmosphere. A gentle mist of water used to dampen the surface of exposed terephthalic acid may reduce dust evolution.

CONSEQUENCE

Water runoff may contain varying amounts of terephthalic acid.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Spills of terephthalic acid or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other materials. Storm drains may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate means.

CONSEQUENCE

Any contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product or contaminated water runoff.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Keep in mind that even small amounts of terephthalic acid dissolved in water will form a rather strong acidic solution.

MITIGATION

Use equipment compatible with the spilled product and its acidic solutions in water as necessary.

TEREPHTHALIC ACID
Non-Regulated

TECHNIQUE

ABSORPTION . . . Spreading of liquids may be controlled by absorbing them with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of afire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil, spilled product, and its residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines. (Note: At least one authority provides data indicating that certain types of soil microorganisms will decompose residues of terephthalic acid in soil in a matter of days, but these microorganisms may not be present at all spill sites.)

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause terephthalic acid dust to become airborne. Use of motorized removal equipment may possibly result in overheating and/or ignition of terephthalic acid or its dust under appropriate conditions.

MITIGATION

Select removal techniques that do not cause terephthalic acid dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply caution if using any equipment that may result in overheating and/or possible ignition of terephthalic dust. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Solid terephthalic acid will sink in water and dissolve at an extremely slow rate. Self purification of water bodies is reported to be affected by concentrations of terephthalic acid in water as low as 0.1 mg/liter. Keep in mind that even small amounts of terephthalic acid dissolved in water will form a rather strong acidic solution. Pay special attention to the "Note" below at the end of the text associated with adsorption techniques.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap solid material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TERETHTHALIC ACID
Non-Regulated

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Use compatible equipment. Consult qualified experts for guidance. See "Note" below at the end of the text associated with adsorption techniques.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through a tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary. (Note: An EPA publication cited by one authority is reported to recommend that contaminants brought up from the bottom via pumping methods first be passed through a gravity separation tank to remove the bulk of heavier than water contaminants and other sediments, be passed through a dual filtration system for further removal of solid particles, and then be passed through an activated carbon filter to remove dissolved chemicals. Be advised that terephthalic acid dissolved in water even in very small amounts may greatly lower the pH of the water. Unless planned by a qualified expert, attempts to neutralize the water may have the potential to increase the toxic hazard associated with the terephthalic acid. This product consists of a benzene ring to which two -COOH groups are attached yet is relatively non-toxic.)

March 1995

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Tetrachloroethylene, also well known by the name perchloroethylene, is a colorless liquid that is practically insoluble in water and heavier. It is not flammable according to standard testing procedures. Its odor is usually described as mildly sweet and as resembling ether or chloroform but can be intense and unpleasant at high concentrations in air. The product is widely used as a solvent, particularly in the dry cleaning industry and where vapor degreasing of metals is conducted, and has numerous other uses. It is of particular concern to environmental officials and occupational health professionals because it is classified as a potential or probable human carcinogen in long-term exposures. Vapors of tetrachloroethylene may be slightly heavier than air, particularly at warmer ambient temperatures. There is a limited possibility that containers exposed to fire or excessive heat for sufficient time duration may rupture violently due to overpressurization. The liquid weighs approximately 13.5 pounds per gallon.

Tetrachloroethylene does not react with water but will decompose extremely slowly in this medium to form trichloroacetic acid and hydrochloric acid. It is stable in transportation and does not react with other common materials. It is reactive with a variety of other chemical substances, however, and forms explosive mixtures or substances with several; reactants of most common concern include chemically active metals, strong oxidizers, strong acids, and caustic substances such as sodium hydroxide and potassium hydroxide. One authority reports the commercial product, which is usually "stabilized" with one or more chemical substances, may be handled in the" presence or absence of air, water, and light with any of the common construction materials at temperatures up to 284°F (140°C). Another reports that the unstabilized material, in the presence of water, is corrosive to aluminum, iron, or zinc. All agree that tetrachloroethylene will attack some forms of plastics, rubber, and coatings. Tetrachloroethylene poses a low to moderate toxic hazard in acute exposures. Products of thermal decomposition which form when the substance is exposed to fire or high temperatures are highly toxic and irritating and are reported to include carbon monoxide, chlorine, hydrogen chloride, phosgene, and possibly other hazardous materials. One major chemical company observes that the amounts of chlorine and phosgene generated are likely to be small.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Practically insoluble; most authorities report 0.016 g/100 g water (160 ppm) at 68°F (20°C) and 0.015 g/100 g water (150 ppm) at 77°F (25°C). One reports 400 ppm at 77°F (25°C).

Solubility in Other Chemicals: Reported as soluble in acetone, alcohol, benzene, carbon disulfide, carbon tetrachloride, chloroform, ether, hexane, and oils.

Specific Gravity (Liquid): 1.62-1.63 at 68°F (20°C)

Boiling Point: 249.8-250.5°F (121.0-121.4°C) at 1 atm.

Melting Point: – 8.86 to – 8.23°F (– 22.7 to – 22.35°C)

Freezing Point: See melting point

Molecular Weight: 165.83

Heat of Combustion: Not flammable

Vapor Pressure: 13-14 4 mm Hg (0.2513-0.2783 psia) at 68°F (20°C); approx 24 mm Hg at 86°F (30°C), these values translate to a saturated vapor concentration of 17,100 to 18,950 ppm at 68°F and about 31,580 ppm at 86°F directly over pools of liquid tetrachloroethylene.

Flash Point: Not flammable

Autoignition Temperature: Not flammable

Burning Rate: Not flammable

Stability: Stable

Corrosiveness: One authority reports the product may be handled in the presence or absence of air, water, and light with any of the common - construction materials at temperatures up to 284°F (140°C). Another reports that the unstabilized material, in the presence of water, is corrosive to aluminum, iron, or zinc. A third notes that the commercial product usually contains stabilizers. Tetrachloroethylene will attack some forms of plastics, rubber, and coatings. One maker of the product recommends use of steel or stainless steel pumps, seamless stainless steel, Teflon or bronze hose, with a note that Viton and cross-linked polyethylene hoses may be used with caution.

Reactivity with Water: No reaction, decomposes extremely slowly in water to form trichloroacetic acid and hydrochloric acid.

Reactivity with Other Chemicals: Tetrachloroethylene forms an impact sensitive explosive when mixed with finely divided barium or lithium; mixture with beryllium powder will flash or spark upon heavy impact; reported to react violently with concentrated nitric acid; when any trichloroethylene is present as an impurity, reactions of tetra chloroethylene with substances such as sodium hydroxide or potassium hydroxide can form dichloroacetylene, a heat-sensitive explosive gas which ignites upon contact with air; may explode if mixed with nitrogen tetroxide and subjected to a shock, incompatible with aluminum under special conditions which may result in fire or explosion and appear to require presence of heat and/or water and/or other substances; generally reported as reactive and incompatible with strong oxidizers, liquid oxygen, strong aclds, and metals such as magnesium and potassium.

IDENTIFICATION

Shipping Names: Tetrachloroethylene (USDOT and IMO)

Synonyms and Tradenames: Carbon bichloride, carbon dichloride; ethylene tetrachloride; perchlorethylene; tetrachloroethene; tetrachlorethylene; 1,1,2,2- tetrachloroethylene, and tradenames and abbreviations such as Ankilostin, Antisol, Didakene, Dow-per, Nema, PCE, Perc Perchlor, Perclene, Perdene, Perk, TCE, Tetracap, Tetralex Tetraleno, Telravec, and Tetropil, among many others.

Chemical Formula: $CI_2C=CCI_2$

Constituent Components (% each): Typically 95% or more pure for dry cleaning and industrial grades. More refined grades may be 99% or more pure. Commercial products often contain minor amounts of various unspecified stabilizers that may be toxic.

UN/NA Designation: UN1897

IMO Designation: 6.1, poisonous material

Physical State As Shipped: Liquid

Physical State As Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Mildly sweet; like ether or chloroform; can be intense and unpleasant at higher concentrations

Common Uses: Dry cleaning solvent; vapor-degreasing solvent; drying agent for metal, wood, and certain other solids general industrial solvent in rubber, printing, soap, paint remover and other industries.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Variably reported as approximately 5 ppm or 50 ppm; odor may become inconspicuous after a short period of exposure at lower levels.

Unusual Hazards: A widely used substance which is highly suspected of causing cancer in humans in long-term exposures and which is of considerable concern as an environmental pollutant.

Short Term Exposure Limit (STEL): 200 ppm for 15 minutes (ACGIH, 1990 – 91)

Time Weighted Average (TWA) Limits: 50 ppm (ACGIH TLV, 1990 – 91) over each 8 hours of a 40 hour work week, 25 ppm (OSHA PEL, 1989) being phased in over time for similar circumstances.

Conditions to Avoid: Contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; contact of vapors with open flames, hot surfaces, welding arcs and similar sources of high heat which may cause thermal decomposition and evolution of toxic and corrosive gases.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to high concentrations of tetrachloroethylene vapors that may be present in the spill area and over some distance downwind. Ingestion and direct contact should also be avoided. Tetrachloroethylene is classified by various authorities as a probable or potential human carcinogen in long-term exposures, such as in the occupational environment. In one case, tetrachloroethylene was detected in human breast milk after the mother experienced a brief exposure to the substance. Her baby developed jaundice and an enlarged liver but quickly recovered after discontinuation of breast feeding. Exposures having no effect on expectant women are reported as not expected to have an effect on the fetus.

Hazards of Skin or Eye Contact: A short single exposure of the skin is not likely to cause significant irritation. Prolonged contact of the skin with liquid tetrachloroethylene results in a progressively severe burning sensation that begins within 5 to 10 minutes of exposure and may result in reddening and occasional blistering. Repeated or prolonged contact may also cause drying, scaling, cracking, and inflammation of the skin due to the defatting action of the product. This can sometimes lead to skin infections. Some amounts may be absorbed through the skin but are considered unlikely by most authorities to pose a significant hazard in single exposures. In the occupational environment, they may contribute to damage of the liver and kidneys. High concentrations of tetrachloroethylene vapors in air may produce varying degrees of eye irritation. Contact of the eyes with the liquid may cause immediate pain, a burning sensation, lachyrmation, inflammation, and possibly temporary corneal injury. Momentary spraying of the liquid into the eyes of a rabbit caused pain and closing of the eyelids; the corneal epithelium became granular and optically irregular with patches being lost, but the eyes recovered completely within two days.

Hazards of Inhalation: Tetrachloroethylene vapors are irritating to the eyes, nose, throat and upper respiratory tract. Exposure to high levels of vapors in air may result in narcosis, central nervous system depression, and other effects with symptoms variously and somewhat inconsistently including flushing of the face and neck, dizziness, headache, drowsiness, fatigue, sweetish metallic taste, tightness in frontal sinuses, numbness around the mouth, increased perspiration of the hands, increased secretions from nasal passages, loss of appetite, nausea, vomiting, an attitude of irresponsibility, an appearance resembling alcoholic intoxication, ringing in the ears, hilarity and/or exhilaration, incoordination, a feeling of fullness in the head, mental confusion, unconsciousness, respiratory failure, and possibly death if the exposure is massive. Non-lethal exposures may result in liver damage with such findings as yellow jaundice and dark urine becoming evident several weeks after the exposure. Damage to the kidneys is also a possibility. Exposure of healthy human adults to 100 ppm for 7 hours causes mild irritation of the eyes, nose and throat, flushing of the face and neck, headache, drowsiness, and slurred speech. Exposure to 475 ppm for 130 minutes causes increased salivation, metallic taste, mild eye irritation, sinus tightness, increased hand perspiration, and increased mucous from nasal passages. A concentration of 600 ppm is reported to have a strong unpleasant odor and to cause definite eye and nasal irritation, dizziness, and loss of inhibition in 10 minutes. At 1000 ppm, the odor said to be intense and markedly irritating; considerable dizziness occurs in about 2 minutes and unconsciousness follows with in 30 minutes according to one authority another reports that 934 ppm causes definite exhilaration, among other effects, after 45 minutes. A concentration of 2000 ppm is reported to cause mild narcosis within 5 minutes. Human volunteers were unable to tolerate 5000 ppm in a chamber for 6 minutesand experienced vertigo, nausea, and mental confusion during the 10 minutes following cessation of exposure. A major chemical company reports that single brief (minutes) exposure to levels above 6000 ppm may be immediately dangerous to life. Rats did not survive when exposed for longer that 12-18 minutes to 12,000 ppm in laboratory experiments. Authorities disagree as to whether excessive exposure may potentially increase sensitivity to epinephrine and increase myocardial irritability. Some conclude that this particular product does not appear to cause this effect while others cite animal experiments which caused cardiac arrhythmias and/or note the similarity of tetrachloroethylene to substances that cause cardiac sensitization. See the “Vapor Pressure” of the product for information on its saturated vapor concentrations at various temperatures.

Hazards of Ingestion:The single dose oral toxicity of tetrachloroethylene is low to moderate. Ingestion may cause irritation of the gastrointestinal tract which in turn may cause nausea, vomiting, diarrhea, and bloody stools. Absorption into the body may cause central nervous system depression and narcosis with many of the symptoms described for inhalation, and especially exhilaration and drunkenness. Liver damage may follow. Aspiration into the lungs during vomiting may result in rapid absorption of the substance and injury to other body systems. It has been reported that any alcohol consumed by the victim before or after the exposure may increase resulting adverse effects. The lowest oral dosage (LDLo) reported to cause deaths among cats and dogs is 4.0 g/kg of body weight; the LDLo for rabbits is reported as 5.0 g/kg. Laboratory experiments have indicated that 2.63 g/kg causes death of 50% of rats while 8.1 g/kg is required to cause a similar effect among mice.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

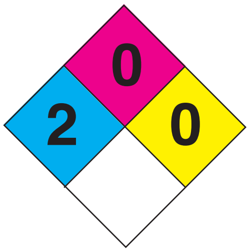
Behavior in Fire: Not flammable. There is a limited possibility that containers exposed to fire may rupture violently due to overpressurization. May generate large quantities of toxic gases upon release.

Hazardous Combustion Products: Highly toxic and irritating gases may be generated if tetrachloroethylene thermally decomposes in a fire. Various authorities list carbon monoxide, chlorine, hydrogen chloride, and phosgene among decomposition products. One major chemical company observes that the amounts of chlorine and phosgene generated are likely to be small.

1897

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)



EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Not flammable. There is a limited possibility that containers exposed to fire may rupture violently due to overpressurization. Contact with other chemicals or certain metals may result in formation of explosive mixtures or substances.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervous and resistant clothing. Compatible materials for tetrachloroethylene may include chlorinated polyethylene, Viton, Viton/neoprene, and Silvershield. Fully encapsulating suits with self-contained breathing apparatus (SCBA) should be considered where personnel may be exposed to dense smoke from a fire that may include large quantities of the irritatlng and corrosive thermal decomposition products of tetrachloroethylene. Such suits may require acid-resistant materials of construction.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent. For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (500 ppm or less) or a chemical cartridge respirator with a full facepiece and with organic vapor cartridges (500 ppm or less) within the use limitations of these devices.

FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues; narcosis and symptoms of central nervous system depression; numerous other symptoms associated with inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit. It may be prudent not to administer sympathomimetic drugs such as epinephrine without specific instructions from a physician since exposure to tetrachloroethylene is said by some authorities to increase myocardial irritability.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if eye or skin irritation persists after washing.

First Aid for Ingestion: Authorities disagree over the proper treatment. As a general course of action, NIOSH says get medical attention immediatelv. If it is not available immediately, induce vomiting if the victim is conscious. Because rapid absorption through the lungs and resultant systemic effects may occur if tetrachloroethylene is aspirated, it is probably best that the decision of whether to induce vomiting or not be made by a physician if one is readily available. The health hazards of aspiration into the lungs must be weighed against the toxicity of the product when considering emptying the stomach. In any case, if vomiting occurs naturally or otherwise, have the victim lean forward to reduce risk of aspiration into the lungs. Do not make an unconscious person vomit.

FIRE RESPONSE

Extinguishing Materials: As necessary for surrounding fire

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Fully-encapsulating suits with self-contained breathing apparatus (SCBA) should be considered where personnel may be exposed to dense smoke from a fire that includes large quantities of the irritating or corrosive thermal decomposition products of tetrachloroethylene. Move container from fire area if no risk. Stop leak if you can do it without risk. Be alert to the possibility, although limited, that the container may rupture violently and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, it may be prudent to an use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate heat sources that may cause thermal decomposition of tetrachloroethylene. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contamination or contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may esult in damage, rupture or other hazard to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the toxicity of tetrachloroethylene into account when planning the response and note that environmental officials are likely to desire an exceptionally thorough cleanup effort, particularly if a surface water body or groundwater is contaminated or at risk of contamination.

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. Tetrachloroethylene discharges may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts have spilled and/or the product is hot when released.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

MONITOR THE SITUATION . . . Tetrachloroethylene may not evolve large amounts of hazardous airborne contaminants in some out door spill situations. It may be advisable in these cases to simply monitor the situation until the spilled product is removed, particularly if only small amounts have spilled in cold weather.

CONSEQUENCE

Hazardous levels of tetrachloroethylene may be found in air in the local spill area and immediately downwind .

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to tetrachloroethylene vapors in air may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of tetrachloroethylene from contact with airborne vapors.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination where deemed necessary. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of tetrachloroethylene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . Liquid tetrachloroethylene is heavier than water and of very low solubility. Application of water via a light spray to the surface of contained liquid pools may reduce emissions of vapors by forming a floating surface layer of water that acts as a vapor blanket.

CONSEQUENCE

Addition of water will increase the volume of liquid contained.

MITIGATION

Contain spilled product and water and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid tetrachloroethylene may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained liquid and spread of contamination.

MITAGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material .

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, vermiculite, perlite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred to reduce the hazard in the event of a fire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination .

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

TETRACHLOROETHYLENE

Division 6.1 (Poisonous Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Liquid tetrachloroethylene will sink in water, dissolve over a long period of time at a very slow but potentially environmentally significant rate, and decompose extremely slowly to form trichloroacetic acid and hydrochloric acid if not recovered. Although the solubility of the product is low, levels of only 5 ppm or so in water may be harmful to some forms of aquatic life in acute exposures and may bioaccumulate in tissues. Due to the probable carcino genicity of the substance, environmental officials are likely to prefer no detectable contamination of drinking water over prolonged periods of time.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2000

1,1,1,2-TETRAFLUOROETHANE

Division 2.2 (Non-Flammable Gas)

GENERAL INFORMATION

Tetrafluoroethane, also known as Halocarbon 134A, is an odorless, colorless non-flammable, liquefied gas. It is used for general analytical/synthetic chemical uses and as a plastic foaming agent and as a refrigerant. The substance is only negligibly soluble in water, most sources reporting only 15% solubility. It is incompatible with strong oxidizers as well as active, alkali or alkaline earth metals, powdered aluminum, magnesium, zinc, beryllium. It is shipped as a liquefied gas and upon release undergoes rapid evaporation (its boiling point is -15.7°F). Tetrafluoroethane is stable and will not undergo hazardous polymerization. The product weighs approximately 10.8 pounds per gallon.

This gas is not flammable or reactive in normal emergency response situations. However, if involved in a fire, tetrafluoroethane can decompose to produce toxic gases (e.g., hydrogen fluoride, phosgene). Tetrafluoroethane is not flammable at temperatures up to 212°F (100°C) at atmospheric pressure. Experimental data have been reported which indicate combustibility of tetrafluoroethane in the presence of certain concentrations of chlorine. Fumes and vapors may be heavier than air. There is a limited potential for containers of liquid to rupture violently if exposed to fire or excessive heat for sufficient time duration.

Tetrafluoroethane is not irritating; however, contact with rapidly expanding gases or the liquefied gas can cause frostbite to exposed tissue. The most significant route of overexposure for tetrafluoroethane is by inhalation. It can cause central nervous system depression after inhalation exposures. Symptoms of such overexposure can include drowsiness, fatigue, and weakness. At high concentrations, the gas can act as an asphyxiant, by displacing oxygen; therefore, exposure to high concentrations of this gas can be fatal.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Negligible (0.15%)
Solubility in Other Chemicals: Reported to be soluble in common solvents.
Specific Gravity (Liquid): 1.20
Vapor Density: 3.6
Boiling Point: -15.7°F (-26.5°C)
Melting Point: -149.8°F (-101°C)
Freezing Point: See melting point.
Molecular Weight: 102
Heat of Combustion: Not flammable
Evaporation Rate (butyl acetate=1): Not applicable (gas).
Vapor Pressure: 4971 mmHg at 77ºF (25ºC)
Flash Point: Not flammable
Autoignition Temperature: >1382°F (750°C)
Burning Rate: Not flammable
Flammable Limits: Not flammable
Stability: Stable
Polymerization Potential: Will not occur.
pH: Not applicable (gas).
Corrosiveness: Unavailable.
Reactivity with Water: No reaction.
Reactivity and Incompatibility: Reacts with strong oxidizers, active metals (sodium, potassium and calcium), alkali or alkaline earth metals, powdered aluminum, magnesium, zinc, beryllium. Freshly abraised aluminum surfaces may cause strong exothermic reactions. Prior to using any plastics, confirm their compatibility with tetrafluoroethane.

IDENTIFICATION

Shipping Name(s): 1,1,1,2-Tetrafluoroethane or Refrigerant gas R 134a (USDOT & IMO)
Synonyms and Tradenames: Tetrafluoroethane; Halocarbon 134A; HFC-134a; Formacel®.
CAS Registry No.: 811-97-2
Chemical Formula: CF_3CH_2F
Constituent Components (% each): Generally 99-100% pure.
UN/NA Designation: UN3159
IMO Designation: 2.2, Non-flammable gases
RTECS Number: TE1008365
NFPA 704 Hazard Rating: 1(Health): 0(Flammability): 0(Reactivity)
Physical Form as Shipped: Compressed liquefied gas
Physical Form as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Odorless, some sources report it to have a slight ethereal odor.
Reportable Quantity: See appendix I.
Common Uses: For general analytical/synthetic chemical uses, as a plastic foaming agent and as a refrigerant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1,1,1,2-TETRAFLUOROETHANE

Division 2.2 (Non-Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: At high concentrations, the gas can act as an asphyxiant, by displacing oxygen; therefore, exposure to high concentrations of this gas can be fatal.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable; Dupont recommends 1000 ppm over an 8 - 10 hour period.

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat; contact with incompatible materials; runoff to sewers or water bodies; inhalation or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard to public is inhalation of fumes or vapors in air or frostbite due to direct physical contact with liquid or fumes. Overexposure may aggravate preexisting disorders of the heart or central nervous system.

Hazards of Skin or Eye Contact: Vapors may irritate the skin. Liquid tetrafluoroethane may cause frostbite; harmful amounts may be absorbed if skin contact is prolonged or widespread. Vapors may irritate the eyes. The liquid may cause severe corneal injury due to frostbite.

Hazards of Inhalation: Asphyxiant. High concentrations can cause headaches, dizziness, drowsiness, and loss of consciousness. Very high concentrations may cause suffocation and can be fatal.

Hazards of Ingestion: An unlikely route of exposure. This product is a gas at normal temperature and pressure, but frostbite of the lips and mouth may result from contact with the liquid.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may rupture violently in fire due to over pressurization. May generate large quantities of toxic vapors and fumes in fire conditions.

Hazardous Combustion Products: Thermal decomposition or burning may produce hydrogen fluoride, hydrogen chloride, carbon monoxide, carbon dioxide, and phosgene-like compounds.

EXPLOSION HAZARDS

Explosive Potential: Not flammable. However, fire conditions can build pressure in container and cause it to rupture. No part of container should be subjected to a temperature higher than 125°F (52°C).

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

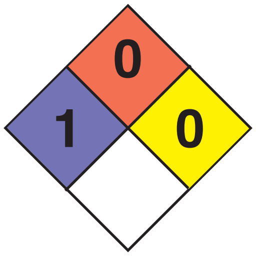
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece may suffice.

3159

1,1,1,2-TETRAFLUOROETHANE

Division 2.2 (Non-Flammable Gas)



FIRST AID

Nonspecific Symptoms: Headaches, dizziness, drowsiness, or frostbite.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Reports vary regarding removal of clothing, due to possibility of frostbite. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water or rub frozen areas.) Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

Note to Physician: Do not administer adrenaline due to the sensitizing effect of fluorocarbons on the myocardium. Treatment of overexposure should be directed at the control of symptoms and the clinical condition. Exposure to fluorocarbon pyrolosis products should be considered in the diagnostic evaluation of occupationally related fever of short duration and unknown origin. Signs of exposure include tachycardia, hyperpnea, and pharyngeal congestion; investigation may reveal pulmonary edema and leucocytosis.

FIRE RESPONSE

Extinguishing Agents: Use extinguishing media appropriate for surrounding fire.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the low boiling point of the product into account while planning the response. Beware of possible heavy gas concentrations in pits, hollows, and depressions.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of tetrafluoroethane in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to tetrafluoroethane vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of tetrafluoroethane from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

1,1,1,2-TETRAFLUOROETHANE
Division 2.2 (Non-Flammable Gas)

TECHNIQUE

FOAM . . . Application of an appropriate firefighting foam to the surface of quiescent liquid pools may slow the release of tetrafluoroethane vapors into the atmosphere after an initial increase in vapor evolution.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Proceed with caution if initial increase in vapor evolution may affect downwind populations.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . If released to soil, material may rapidly evaporate or undergo extensive leaching in moist soil, possibly contaminating ground water supplies. Building dikes or barriers using soil, sand or other related materials may confine spills of material. Where liquids are likely to come in contact with water from runoff or rain, confinement barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Confined tetrafluoroethane may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders. (Note: Most residue will rapidly evaporate.)

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

1,1,1,2-TETRAFLUOROETHANE

Division 2.2 (Non-Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with dissolved chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

This page may be used for notes.

January 1988

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Tetrahydrofuran is a volatile colorless liquid with an ether-like faint fruity odor. It is used as a solvent for resins, pharmaceuticals, and inks, and for making other chemicals. It is fully soluble in water. Its flash point of 6°F (or less) indicates that it is easily ignited under most ambient temperature conditions. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.4 pounds per gallon.

Tetrahydrofuran is stable in normal transportation but should not be placed in prolonged storage in the presence of air. This may result in the formation of peroxides that may explode if the solution is later concentrated by evaporation or distillation. The product does not react with water or other common materials, but reactions with sodium or potassium hydroxide, a mixture of sodium and aluminum, borane, or heated metallic hydrides may be explosive under appropriate conditions, and the product otherwise reacts (and may polymerize in some cases) with various acids, strong oxidizers, and lithium aluminum hydride. Tetrahydrofuran is generally noncorrosive to metals at normal temperatures, but may attack some forms of plastics, rubber and coatings. It is of low to moderate toxicity by the various routes of exposure, but high concentrations may be present in air. Products of combustion are toxic and include peroxides.

Downwind evacuation should be considered if tetrahydrofuran is leaking but not on fire. If a fire becomes uncontrollable or the container is exposed to direct flame, evacuate for a radius of one-third (1/3) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in all proportions
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, ether, and organic solvents.
Specific Gravity (Liquid): 0.886 - 0.889 at 68°F (20°C)
Boiling Point: 149 - 152.6°F (65 - 67°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: - 163.3°F (- 108.5°C)
Molecular Weight: 72.1
Heat of Combustion: - 8330 cal/g
Vapor Pressure: 143 - 145 mm Hg (2.76 - 2.80 psia) at 68°F (20°C)
Flash Point: 6°F (- 14.5°C), closed cup; - 4°F (- 20°C) or 5°F (- 15°C), open cup.
Autoignition Temperature: 610°F (321°C)
Burning Rate: 4.7 mm/minute
Stability: Stable unless peroxides have accumulated due to prolonged presence in air.
Corrosiveness: Noncorrosive to metals at ordinary temperatures. Will attack some forms of plastics, rubber and coatings.
Reactivity with Water: *No* reaction
Reactivity with Other Chemicals: Reacts with many acids, lithium aluminum hydride, sodium or potassium hydroxide, sodium and aluminum mixture, borane, heated metal hydrides, and strong oxidizers.

IDENTIFICATION

Shipping Names: Tetrahydrofuran (USDOT and IMO)
Synonyms and Tradenames: Butane, 1,4-epoxy; butylene oxide; cyclotetramethylene oxide; diethylene oxide; furanidine; hydrofuran; oxacyclopentane; oxolane; tetramethylene oxide; THF.
Chemical Formula: $-CH_2(CH_2)_2CH_20$
Constituent Components (% each): Mostly pure with traces of water, THF hydroperoxide, and butylated hydroxytoluene (to prevent peroxide formation).
49 STCC: 49 082 90
UN/NA Designation: UN2056
IMO Designation: 3.1, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Ether-like; faint fruity odor; similar to acetone.
Common Uses: Solvent for resins, topcoating solutions, cellophane, adhesives, magnetic tapes, inks, pharmaceuticals, etc.; mfg. of other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 20 - 50 ppm

Unusual Hazards: Potentially explosive peroxides form upon prolonged exposure to air. Product is a volatile flammable liquid with heavier than air vapors.

Short Term Exposure Limits (STEL): ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; prolonged exposure to air.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations in air that may result from spillage of this product. Ingestion and direct physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated skin contact with liquid tetrahydrofuran may result in drying and cracking of the skin due to the defatting action of the product. Contact with the eyes results in irritation and possible burns.

Hazards of Inhalation: Vapors of tetrahydrofuran are irritating to the eyes and nose. High concentrations in air are narcotic and may cause nausea, dizziness, headache, weakness, unconsciousness, and possibly asphyxiation. Concentrations above 25000 ppm (2.5%) in air produce anesthesia with small margin of safety between anesthesia and death.

Hazards of Ingestion: Ingestion may result in gastrointestinal irritation, nausea, vomiting, and diarrhea. Aspiration into the lungs during vomiting may cause severe lung irritation or chemical pneumonitis (possibly delayed).

FIRE HAZARDS

Lower Flammable Limit: 1.8 - 2% at 77°F (25°C)

Upper Flammable Limit: 11.8% at 77°F (25°C)

Behavior in Fire: Flammable liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. May generate significant quantities of flammable vapors upon release.

Hazardous Combustion Products: Include peroxides and other toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: 2.3%

Upper Explosive Limit: 11.8%

Explosiveness: Containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area. Contact with certain other chemicals may result in formation of explosive mixtures (see General Information section). Peroxides form upon prolonged exposure of the product to air. These may explode if concentrated by evaporation of the product.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 10000 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted organic vapor canister (10,000 ppm or less) or an organic vapor cartridge respirator with a full facepiece (1000 ppm or less) within the use limitations of these devices.

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

FIRST AID

Nonspecific symptoms: Irritation of the eyes or nose; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Do not induce vomiting. Keep victim warm and at rest. Get medical attention immediately. (Note: NIOSH suggests that vomiting be induced only if the victim is conscious and immediate medical attention is not available.)

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, dry chemical, carbon dioxide; water fog. Water may be ineffective but may be used to dilute spills to nonflammable mixtures.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that tetrahydrofuran is a volatile flammable liquid with heavier than air vapors. Also, that it is reactive and explosive under conditions described in the General Information section.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Tetrahydrofuran spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to tetrahydrofuran vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain varying amounts of tetrahydrofuran from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid tetrahydrofuran may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of tetrahydrofuran vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Apply alternative technique if the response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Tetrahydrofuran may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained tetrahydrofuran may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal. Consult qualified experts for safe treatment techniques.

TETRAHYDROFURAN
Class 3 (Flammable Liquid)

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1997

4-THIAPENTANAL

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

4-Thiapentanal, also known as methylmercaptopropionaldehyde, is a colorless liquid with an extremely foul and persistent odor. It is used as a food additive. Sources vary on its solubility from being completely insoluble to only negligibly soluble at .05%. With a specific gravity of 1.054, it is only slightly heavier than water. It has a vapor density of 3.5 making it much heavier than air and can expected to be found in low laying areas in the vapor phase. However, considering that it has a low evaporation rate, a low vapor pressure and a high boiling point, not much vapor is expected to be generated. It has a high boiling point of 161.4°C and a low melting point of -58°C (-72.4°F). It has a relatively wide range of flammable limits, ranging from 1.3% to 36.1%. Although it is generally reported to be stable, it will slowly polymerize on standing and at least one source reports that hazardous polymerization will occur while the others report that hazardous polymerization will not occur. It will decomposes rapidly in contact with acids and bases, and may produce sulfur dioxide. Although 4-thiapentanal will not readily ignite, it will burn if exposed to sources of heat and flame. During a fire, methylmercaptan and acrolein may be produced, as well as carbon dioxide and carbon monoxide.

4-Thiapentanal is moderately toxic. Contact with the eyes can, in severe and untreated exposure, result in permanent eye damage. All routes of entry apply and result in some level of irritation.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble, <.05%; one source reports 75 g/l

Solubility in Other Chemicals: Unavailable

Specific Gravity: 1.054

Vapor Density (Air=1): 3.5

Boiling Point: 161.4°C (322.5°F)

Melting Point: -58°C (-72.4°F)

Freezing Point: See melting point

Molecular Weight: 104.18

Heat of Combustion: Unavailable

Evaporation Rate (Butyl Acetate=1): .08

Vapor Pressure: 2 mm Hg;1mm Hg at 20°C (68°F)

Flash Point: 60°C (140°F) (cc); 85°C (185°F) (open cup)

Autoignition Temperature: Not available

Burning Rate: Not available

Flammable Limits: 1.3% (LUL) - 36.1% (UEL)

Stability: Stable, although will slowly polymerize on standing.

Polymerization Potential: Slowly polymerizes on standing producing strong bases, although hazardous polymerization will not occur. One source reports that it will occur.

pH: Not available

Corrosiveness: Not available

Reactivity and Incompatibility: Decomposes rapidly in contact with acids and bases.

Other Characteristics: May produce sulfur dioxide.

IDENTIFICATION

Shipping Name(s): 4-Thiapentanal (USDOT & IMO)

Synonyms and Tradenames: MMP; Methionol; beta-(Methylmercapto) propionaldehyde; 3-(Methylmercapto) propionaldehyde; Methylmercaptopropionaldehyde; 3-(Methylthio) propanol; beta-(Methylthio) propionaldehyde; 3-(Methylthio) propionaldehyde; Propanal, 3-(methylthio)-(9Cl); Thia-4-pentanal.

CAS Registry No: 3268-49-3

Chemical Formula: $CH_3SCH_2CH_2CHO$

Constituent Components (% each): over 97%

UN/NA Designation: UN2785

IMO Designation: 6.1

RTECS Number: UE2285000

NFPA 704 Hazard Rating: Not reported (Health); 2 (Flammability); 0 (Reactivity)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Extremely foul and persistent odor.

Reportable Quantity: See appendix I

Common Uses: Flavor and fragrance use in foods

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

4-THIAPENTANAL

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.2 - 0.5 ppb.

Unusual Hazards: During a fire, methylmercatan and acrolein may be produced. Moderately toxic.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): 2ppb (Based on extreme foul odor which causes nausea.)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Inhalation, ingestion, eye or skin contact; strong bases or acids; prolonged exposure to high temperatures (above 75°C (167°F) for 4-5 hours).

HEALTH HAZARDS

Potential Health Hazards: Material is moderately toxic. Contact with the eyes, in severe and untreated exposure, may result in permanent eye damage. All routes of entry apply and result in some level of irritation.

Hazards of Skin or Eye Contact: Contact with skin may cause local redness and swelling. Contact with eyes may cause stinging or burning sensations with excessive tearing and blinking. Liquid can cause severe irritation, experienced as discomfort or pain, excess tearing or blinking, marked excess redness and swelling of the conjunctiva, and chemical burns of the cornea. Corneal injury may be severe, extensive and if not treated promptly, could result in permanent impairment of vision.

Hazards of Inhalation: Inhalation may cause headache, excess salivation, nausea, vomiting, diarrhea and possibly dizziness and weakness. There may be nasal discomfort with discharge, cough, discomfort and tightness in the chest, and difficulty with breathing. Extremely foul odor at very low concentrations can cause nausea.

Hazards of Ingestion: This product is moderately toxic. Ingestion may cause abdominal discomfort, nausea, vomiting, diarrhea, dizziness, drowsiness, faintness, weakness, collapse and coma. May cause moderate to marked irritation of the mouth, throat, esophagus and stomach. Aspiration may occur during ingestion or vomiting, resulting in lung injury.

FIRE HAZARDS

Lower Flammable Limit: 1.3%

Upper Flammable Limit: 36.1%

Behavior in Fire: Although 4-thiapentanal will not readily ignite, it will burn if exposed to sources of heat and flame. During a fire, methylmercaptan and acrolein may be produced, as well as carbon dioxide and carbon monoxide.

Hazardous Decomposition Products: Produces acrid fumes and smoke.

Hazardous Combustion Products: During a fire, methylmercaptan and acrolein may be produced, as well as carbon dioxide and carbon monoxide.

EXPLOSION HAZARDS

Explosive Potential: Moderate, however containers exposed to prolonged heat and flame may explode and violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

Protective Clothing Required: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots and gloves may be worn.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

2785

4-THIAPENTANAL

Division 6.1 (Poisonous Material)

*Not reported

FIRST AID

Nonspecific Symptoms: Material can cause irritation by all routes of entry. Aspiration hazard exists if material is swallowed

First Aid for Inhalation: In case of inhalation, remove patient to fresh air. If patient is having difficulty breathing, administer oxygen or if patient is not breathing give artificial respiration. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material is gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: In case of ingestion, have victim drink large quantities of milk or water if victim is conscious. Do not induce vomiting. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Water spray (fog) and alcohol or all purpose foam is recommended for large fires, while carbon dioxide or dry chemical is recommended for smaller fires.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or re-ignition may occur. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable and/or toxic. Underflow dams are not an effective means to dike material since it soluble in water. As a result, recovery efforts from water borne releases are difficult. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . 4-Thiapentanal, usually, will not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of 4-thiapentanal in air may be found in the local spill area and immediately downwind under appropriate circumstances. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of toxic vapors.

MITIGATION

Remove spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Personnel should conduct periodic air monitoring of the area to determine if toxic concentrations exist and when conditions are safe to reenter the area.

TECHNIQUE

WATER SPRAY OR FOG . . . Water spray or fog applied to 4-thiapentanal in air may reduce vapor generation.

CONSEQUENCE

Water build-up could cause material to spread.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Foam or compatible hazardous materials foam agents may be applied to the surface of liquid pools to reduce vapor generation.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Building dikes or barriers using soil, sand or other related materials may contain spills of material. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material may be mobile in soil and may seep through dike material, which may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches.

4-THIAPENTANAL

Division 6.1 (Poisonous Material)

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to condition such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Continually monitor for the presence of flammable vapors. Decontaminate equipment.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Material is slightly heavier than water. Use natural deep water pockets, excavated lagoons or sand bag barriers to trap material on bottom and limit spread of contamination.

4-THIAPENTANAL
Division 6.1 (Poisonous Material)

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may spread contaminate.

MITIGATION

Excavate as last resort, unless adverse environmental impacts can be minimized.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottoms sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Since the material is just slightly heavier than water booms may be an effective means to recover spilled material since some may remain on the surface. Barriers of suitable material may be used to confine the spill to a limited area to prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July, 1994

THIONYL CHLORIDE
Class 8 (Corrosive Material)

GENERAL INFORMATION

Thionyl chloride is a colorless or pale yellow to red liquid with a sharp, suffocating, irritating odor. It is not flammable, however, it is extremely corrosive and reacts violently with water. This reaction may result in the generation of substantial volumes of hydrogen chloride and sulfur dioxide gas with a reported liquid to vapor expansion ratio of 1:3700. As a result, reactions with water in closed containers can generate substantial pressures. This may result in the pressure rupture of the container. Thionyl chloride may react with metals in the presence of moisture to form hydrogen chloride, sulfur dioxide, and hydrogen gases.

On the release of liquid thionyl chloride, vapor generation is likely to be confined to the immediate spill vicinity. When dealing with spills of thionyl chloride, great care should be exercised in the use of water. Attempts to dilute spills of thionyl chloride with water may result in the development of substantial releases of vapors and acid mists. This can result in greatly expanding the threat of exposure well beyond the spill area.

Thionyl chloride is extremely corrosive to living tissues and may cause severe bums. These burns will be characteristic of hydrochloric acid exposures. Vapors and mists evolving from thionyl chloride spills are also extremely corrosive to living tissues.

In an accident situation, if thionyl chloride is leaking and generating fumes, downwind evacuation of the spill area should be considered until properly equipped responders have assessed the nature of the threat. Because of the potential for the generation of large quantities of hydrochloric acid mist, the spill assessment should note the potential for large quantities of thionyl chloride to combine with water.

Thionyl chloride is used in the manufacture of a variety of engineered plastics and as a chlorinating agent in various manufacturing reactions. It is also used in the manufacture of some pesticides and as a laboratory reagent.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Violently decomposes in water.

Solubility in Other Chemicals: Soluble in benzene and carbon tetrachloride.

Specific Gravity (Liquid): 1.638

Vapor Density (Air=1): *4.1*

Boiling Point: 76 to 79°C (168.8 to 174.2°F)

Melting Point: *-105°C* (-157°F)

Freezing Point: -105°C (-157°F)

Molecular Weight: 118.97

Heat of Combustion: Non-flammable.

Vapor Pressure: 94 to 97 mmHg @ 20°C (68°F)

Flash Point: Non-flammable.

Autoignition Temperature: Non-flammable.

Burning Rate: Non-flammable, decomposes.

Stability: Decomposes at 140°C (284°F) forming hydrogen chloride, chlorine, sulfur dioxide, and sulfur chlorides. Not subject to violent polymerization.

Corrosiveness: Corrosive to tissue and metals such as aluminum, magnesium, titanium, and in the presence of moisture, steel.

Reactivity with Water: Violently decomposes in water producing fumes including sulfur dioxide and hydrogen chloride.

Reactivity with Other Chemicals: Reacts violently with alkali materials (acid - base reaction) with the liberation of acid vapors and heat. It reacts with oxygen containing organic compounds, sodium, magnesium, aluminum, and titanium.

IDENTIFICATION

Shipping Names: Thionyl chloride.

Synonyms and Tradenames: Sulfurous oxychloride; sulfur oxychloride; sulphinyl chloride; CAS 7719-09-7.

Chemical Formula: $SOC1_2$

Constituent Components (% each): Typically 99% thionyl chloride.

UN/NADesignation: UN1836

IMO Designation: 8, corrosive.

Physical State as Shipped: Liquid.

Physical State as Released: Liquid.

Color of the Shipped Material: Colorless or pale yellow to red liquid.

Odor Characteristics: Suffocating odor, sharp, irritating.

Common Uses: Used in the manufacture of pesticides, engineering plastics, and as a chlorinating agent.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

THIONYL CHLORIDE
Class 8 (Corrosive Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Corrosive to tissues. Reacts with water, violently, to liberate hydrogen chloride and sulfur dioxide gasses or mists.

Short Term Exposure Limits (STEL): Unavailable.

Time Weighted Average (TLV-TWA): 1 ppm (5 mg/m^3) air, OSHA PEL - CEILING.

Conditions to Avoid: Contact with water or incompatible materials; runoff to sewers or water; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Corrosive to skin, mucous membranes and eyes. Reactions with water will liberate vapors composed of hydrogen chloride and sulfur dioxide. Reactions with water may result in the evolution of substantial acid vapor cloud increasing the threat of downwind exposure.

Hazards of Skin and Eye Contact: Eye exposure can result in severe burns to eye tissue. Extent and duration of exposure will determine the severity of the injury which could result in permanent blindness. Severe acid burns to the skin are likely to result from thionyl chloride exposures. Bums may be deep, penetrating below the skin depending on the nature of the exposure. Burns will be typical of those produced by hydrochloric acid exposures.

Hazards of Inhalation: Severe respiratory irritant. Corrosive to respiratory mucous membranes. Symptoms include coughing and wheezing. May progress to acute pulmonary edema and chemical pneumonitis. Inhalation exposures may be fatal depending on the concentration and duration of exposure. Burns may progress even after removal from exposures due to the continued action of hydrochloric acid residues.

Hazards of Ingestion: Highly corrosive to tissues in the mouth, esophagus, and stomach. May result in severe burns to the exposed tissues.

FIRE HAZARDS

Lower Flammable Limit: Non-flammable.

Upper Flammable Limit: Non-flammable.

Behavior in Fire: Thionyl chloride is non-flammable but will decompose if involved in fire. If thionyl chloride is exposed to water, as from fire suppression efforts, it will decompose to sulfur dioxide and hydrochloric acid. Sealed containers, exposed to excessive heat, may rupture due to thionyl chloride decomposition, to gasses and resulting in an increase in pressure.

Hazardous Combustion Products: Likely decomposition products include thionyl chloride vapor, hydrogen chloride, chlorine, and sulfur dioxide gasses.

EXPLOSION HAZARDS

Explosiveness: Contamination of thionyl chloride in closed containers may result in container rupture due to over pressure from gas generation.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: *Full* acid suit, gloves, protective boots and chemical goggles and full face shield or comparable protective equipment is necessary when dealing with thionyl chloride releases. Equipment should protect from all direct contact with thionyl chloride. Suitable materials of construction are reported to include butyl rubber and neoprene.

Respiratory Protection: OSHA/NIOSH approved acid gas canister for low concentrations. Full respiratory protection. Positive pressure, self contained breathing apparatus or supplied air systems with full facepiece (or equivalent) are recommended for high or unknown concentrations.

1836

THIONYL CHLORIDE
Class 8 (Corrosive Material)

FIRST AID

Nonspecific Symptoms: Severe burns to any tissues involved depending on the level of exposure. Eye contact may result in permanent damage or blindness. Severe corrosion of respiratory tissues depending on the level of exposure. Symptoms may include coughing, wheezing, choking, pulmonary edema, chemical pneumonitis. Symptoms may progress after removal from exposure due to residual contamination. Pulmonary symptoms may continue to develop after removal from exposure and victims should be observed for development/progression of pulmonary edema and delayed chemical pneumonia.

First Aid For Inhalation: Remove victim to fresh air. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert to signs of respiratory distress. Edema in respiratory tissues may grow progressively worse following acute exposure resulting in increased respiratory distress with time. Symptoms of pulmonary edema and chemical pneumonia may continue to develop for some time (1-2 days) after exposure. Seek medical assistance immediately.

First Aid For Skin and Eye Contact: Remove contact lenses, if possible without increasing eye injury. Flush eyes immediately with clean water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Severe exposures may result in permanent eye damage or blindness. Remove contaminated clothing and wash contaminated skin with water or soap and water. Seek medical assistance immediately.

First Aid for Ingestion: *Do* not induce vomiting. If victim is conscious, administer large quantities of water or milk. Never give anything by mouth to an unconscious person. Seek medical assistance immediately.

FIRE RESPONSE

Extinguishing Materials: Not flammable. Materials should be appropriate to the fuel involved.

Extinguishing Techniques: The use of water to control fire in the vicinity of spilled thionyl chloride should be weighed against the threat of vapor generation from the reaction of thionyl chloride and water. Introducing water into containers containing thionyl chloride should be avoided. Spilled thionyl chloride should be protected from contact with water runoff to minimize the generation of acid mists.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to spill area. Avoid contact with spilled material. Prohibit unprotected personnel from entering spill area. Seek expert assistance. Protect sewers and waterways from spilled thionyl chloride or contaminated runoff. Notify authorities, downstream of spill, of the potential for contamination. Be alert to conditions which may result in the mixing of water with spilled thionyl chloride. Protect spills from contact with water, if possible, to avoid excess acid mist generation. Keep in mind that thionyl chloride reacts with water to form hydrochloric acid and sulfur dioxide. Choose equipment which is compatible with thionyl chloride. Contact with steel in the presence of moisture can result in the generation of hydrogen gas.

THIONYL CHLORIDE
Class 8 (Corrosive Material)

AIR SPILL

TECHNIQUE

EVACUATION... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Thionyl chloride, when reacting with water, will form sulfur dioxide and hydrochloric acid mist. Releases may expose downwind areas to toxic concentrations over considerable distances depending on the rate of mist generation.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Seek expert assistance. Stop leak if without risk and if proper equipment and trained personnel are available. Allow vapors and gas to dissipate completely before reentering spill area without special protective gear.

TECHNIQUE

MONITOR THE SITUATION... Thionyl chloride may not evolve large amounts of hazardous airborne contaminants if moisture levels are low and thionyl chloride is kept away from water. It may be advisable, in some cases, to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of thionyl chloride vapors may concentrate in the vicinity of the spill area and in nearby enclosed or low lying areas.

MITIGATION

Remove spilled thionyl chloride as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel. Check low lying areas and structures in the spill vicinity for thionyl chloride vapor concentration.

TECHNIQUE

WATER FOG OR SPRAY... Water fog applied to thionyl chloride vapors and mists may accelerate its dispersal in the atmosphere. Thionyl chloride will likely react with water to form hydrochloric acid.

CONSEQUENCE

Adding water to spilled thionyl chloride will result in the generation of significant quantities of acid mist. Water runoff may contain levels of hydrochloric acid from contact with thionyl chloride. Water will become acidic and the pH will depend on the levels of acid generated. High levels of hydrochloric acid in solution will pose a significant hazard. Refer to the **Hydrochloric acid, *Emergency Action Guide*** for further information.

MITIGATION

Do not expose standing pools of thionyl chloride to contact with water. Do not spray water in containers of thionyl chloride. Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may contact spilled thionyl chloride and take steps to prevent such contact. Refer to the **Hydrochloric acid, *Emergency Action Guide*** for further information.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES... Spills of thionyl chloride on land may be contained by building dikes or barriers using soil, sand, or other materials. Where thionyl chloride is likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

CONSEQUENCE

Thionyl chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

LAND SPILL *(CONTINUED)*

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions, such as fire hose runoff or rainwater which may react with contained thionyl chloride. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking product.

CONSEQUENCE

Thionyl chloride may percolate into soil. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination. Excavations will expose moist soil to thionyl chloride and may increase the rate of vapor generation. Excavations exposing groundwater will promote the generation of large amounts of acid mist.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater which may cause increased vapor generation. Where possible, line containment areas with suitable, impervious material. Do not excavate deep enough to risk exposing product to groundwater.

TECHNIQUE

PUMPINGNACUUM SUCTION... Accumulated liquid pools may be recovered using appropriate hoses, pumps, and storage containers or vacuum trucks. Care should be taken to use equipment which is compatible with thionyl chloride as it may react with steel in the presence of moisture to generate flammable hydrogen gas. Equipment should be dry to avoid contact with water.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed. Reaction with steel in the presence of moisture may generate hydrogen gas. Water contained in equipment may increase the generation of mist or vapor.

MITIGATION

Use equipment constructed of compatible materials. Insure equipment is free from water. Arrange to decontaminate equipment after use. Plan for the removal of remaining contaminated soil after product is removed.

TECHNIQUE

ABSORPTION... Spilled thionyl chloride can be absorbed and immobilized with inert, non-combustible materials such as sand, earth, vermiculite, and compatible commercial sorbants.

CONSEQUENCE

Sorbants will become contaminated with thionyl chloride and will pose the same hazards as the spilled product. Use of sorbants will add to the overall volume of the spill.

MITIGATION

Reduce spill volume by removing product directly using mechanical means, if possible. Use sorbants to remove residues which are left behind.

TECHNIQUE

MECHANICAL REMOVAL... Thionyl chloride contaminated soil may be removed by shovels, motorized graders, scrapers, loaders, buldozers and draglines.

THIONYL CHLORIDE
Class 8 (Corrosive Material)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use with soap and water. Use equipment which is compatible with spilled product. Avoid equipment constructed with copper or copper alloys. Store contaminated materials in a safe and secure location.

WATER SPILL

Thionyl chloride will react in water to form hydrochloric acid. Refer to the **Hydrochloric acid**, ***Emergency Action Guide*** for further guidance.

TECHNIQUE

STOP USE... Notify downstream industrial, municipal, and public users to stop intake or monitor water for contamination. Stop recreational water use in downstream areas.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternate water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT/DIVERSION... Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

January 1988

THORIUM ORE
Class 7 (Radioactive Material)

GENERAL INFORMATION

Thorium ore, also known as monazite sand, is a natural material of low radioactivity found in N. Carolina, S. Carolina, Idaho, Colorado, Montana, Florida, Canada, and several other parts of the world. It is used to produce thorium and its compounds, uranium, cerium, and other rare-earth metals and compounds. It is considered insoluble in water and is substantially heavier, so may be expected to sink while dispersing through natural water columns. Some constituents of the material may be flammable and may emit hazardous fumes in fires, but the flammability and several other characteristics of the materials are not well defined. The ore weighs 306 - 331 pounds per cubic foot. Composition varies with source but may include thorium, yttrium, cerium and lanthanide metals and compounds, calcium, iron, silica, uranium 308, and thorium dioxide. The latter compound may constitute as much as 10% of the material. Local, state, or U.S. Department of Energy radiological response teams should be contacted for advice if the ore is released to the environment. Note, however, that thorium ore is only mildly radioactive and that the radiation hazard in transportation is relatively minor.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble
Solubility in Other Chemicals: Thorium dioxide is soluble in hot sulfuric acid.
Specific Gravity (Solid): 4.9 - 5.3
Boiling Point: Unavailable
Melting Point: Unavailable
Freezing Point: Unavailable
Molecular Weight: Unavailable
Heat of Combustion: Unavailable

Vapor Pressure: Unavailable
Flash Point: Unavailable
Autoignition Temperature: Unavailable
Burning Rate: Unavailable
Stability: Unavailable
Corrosiveness: Unavailable
Reactivity with Water: Unavailable
Reactivity with Other Chemicals: Unavailable

IDENTIFICATION

Shipping Names: Thorium ore (USDOT)
Synonyms and Tradenames: Monazite sand
Chemical Formula: $(Ce,La,Y,Th)P0_4$ for monazite
Constituent Components (% each): Varies
49 STCC: 49 264 39
UN/NA Designation: UN2912
IMO Designation: *7,* radioactive substance
Physical State as Shipped: Solid

Physical State as Released: Solid
Color of the Shipped Material: Yellowish to reddish brown
Odor Characteristics: Unavailable
Common Uses: Mfg. of thorium and its compounds, uranium, cerium, and other rare-earth metals and compounds.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

THORIUM ORE

Class 7 (Radioactive Material)

USDOT: Identification numbers
cannot be displayed on the placard
(49 CFR § 172.334).

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Radioactive solid of low specific activity.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Conditions to Avoid: Exposure to fire; entry to sewers or water bodies; inhalation of dust, ingestion, and direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Not well defined but include low level radioactivity. It is best to avoid all exposures. Seek advice from radiological response team.

Hazards of Skin or Eye Contact: None reported.

Hazards of Inhalation: The toxicity of thorium ore dust in single and limited exposures is considered low but some constituents may be carcinogenic and should be avoided.

Hazards of Ingestion: Unavailable

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Some constituents may burn.

Hazardous Combustion Products: Fumes from material in fire may be hazardous.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Data unavailable.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from contact with the spilled thorium ore. Seek advice from radiological response team.

Respiratory Protection: *A* dust respirator with high efficiency particulate cartridge(s) is presumably adequate for normal exposures. Seek advice from a radiological response team.

FIRST AID

Nonspecific symptoms: Unavailable

First Aid for Inhalation: Remove victim to fresh air. Get medical attention.

First Aid for Skin and Eye Contact: Brush off loose materials and wash affected areas.

First Aid for Ingestion: Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Data unavailable.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use water to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Prevent entry to water bodies and sewers. Eliminate ignition sources as a safety precaution. Notify proper authorities, downstream sewer and water treatment operations, and other downstream user of potentially contaminated water. Seek advice from local, state, or federal radiological response team.

2912

THORIUM ORE
Class 7 (Radioactive Material)

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Thorium ore may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of thorium ore dust in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid thorium ore with plastic sheet or other compatible material to prevent airborne dust. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to thorium ore dust in air may knock down dust and accelerate its dispersal in the atmopshere.

CONSEQUENCE

Water runoff may contain varying amounts of thorium ore dust from contact with dust.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Thorium ore may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Entry of water to containment area may conceivably spread contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause thorium ore dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

THORIUM ORE
Class 7 (Radioactive Material)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage.

MITIGATION

Consult qualified experts for guidance.

September 1992

TITANIUM DIOXIDE
Non-Regulated

GENERAL INFORMATION

Titanium dioxide is not designated as a hazardous material in transportation. Nevertheless, the substance is consistently ranked among the top 50 chemicals produced in the United States and may therefore be encountered comparatively frequently in transportation or other accidents resulting in a chemical discharge.

Titanium dioxide is usually shipped as solid white crystals or powders, or alternatively, as a slurry in water containing 50 to 80% of the solid by weight. The product is odorless, noncombustible, heavier than water, and insoluble therein. Although generally white or colorless when pure, titanium dioxide is found in nature in various forms containing impurities that impart a variety of different colors. It is primarily used as a pigment and coloring agent to provide a white color to a wide variety of consumer products but also has a number of more specialized uses in commerce. Solid titanium dioxide weighs approximately 240 to 266 pounds per cubic foot.

Titanium dioxide does not react with water or other common materials, is very stable (even when exposed to fire), and is reported to be generally non-corrosive. Toxicity of the product is very low by all routes of exposure. It is reported not to evolve products of thermal decomposition and/or combustion in a fire, and as noted above, is not itself combustible.

The data and information presented below are for relatively pure titanium dioxide. The properties and hazards of the material may be altered if it is mixed with other substances or contains significant amounts of impurities.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble

Solubility in Other Chemicals: Soluble in hot concentrated sulfuric acid; hydrofluoric acid; or alkali.

Specific Gravity (Solid): 3.84 - 3.90 for anatase; 4.13 - 4.17 for brookite; and 4.23 - 4.26 for rutile; all at room temperatures.

Boiling Point: 4530 - 5430°F (2500 - 3000°C) at 1 atm.

Melting Point: Most references list a melting point temperature in the range of 3320 - 3380°F (1825 - 1860°C); some provide a lower value of 2985°F (1640°C).

Freezing Point: See melting point

Molecular Weight: 79.9

Heat of Combustion: Not combustible

Vapor Pressure: Essentially zero at 68°F (20°C)

Flash Point: Not combustible

Autoignition Temperature: Not combustible

Burning Rate: Not combustible

Stability: Stable

Corrosiveness: Simply reported to be non-corrosive

Reactivity with Water: No reaction

Reactivity with Other Chemicals: One authority reports that a reaction between titanium dioxide and lithium occurs at a temperature of about 390°F (200°C) with a flash of light and that the temperature can eventually reach 1650°F (900°C).

IDENTIFICATION

Shipping Names: No particular name is standard but "chemicals, n.e.c." The shipper may or may not provide the specific chemical name of the product.

Synonyms and Tradenames: Anatase; brookite; rutile; titania; titanic acid anhydride; titanic anhydride; titanic oxide; titanium dioxide; titanium peroxide; titanium oxide; titanium white; and many tradenames.

Chemical Formula: $Ti0_2$ for the pure substance

Constituent Components (% each): One authority reports that the product usually contains small amounts of the oxides of aluminum, antimony, silicon (quartz) and zinc, and may sometimes contain very small (ppm) amounts of metals such as iron, chromium and vanadium.

28 STCC: 28 161 25 (titanium dioxide, nec); 28 161 35 (titanium dioxide, ultra fine powder); 28 161 30 (titanium dioxide and water mixed, consisting of not exceeding 78% by weight of titanium dioxide).

UN/NA Designation: Not established

IMO Designation: Not established

Physical State As Shipped: Solid crystals or powders; slurries consisting of solid titanium dioxide mixed with water.

Physical State As Released: Same as shipped

Color of the Shipped Material: Pure titanium dioxide is a white powder or fine, needle-like crystals which may be individually colorless but nevertheless appear white in a container. Crystals of the substance found in nature usually contain impurities which color them yellow, red, reddish-brown, green, blue, black or brown.

Odor Characteristics: Odorless

Common Uses: Widely used as a white pigment and coloring agent in ceramics, cosmetics, floor coverings, food additives, glassware, inks, paints, paper, plastics, rubber, tanners' leather finishes, shoe whiteners, coated textiles, wall coverings, and other products.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

TITANIUM DIOXIDE
Non-Regulated

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Reported to be odorless

Unusual Hazards: None

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limits: 10 mg/m^3 (as total dust containing no asbestos and less than 1% crystalline silica) over each 8 hours of a 40 hour work week (ACGIH TLV, 1990-91); 10 mg/m^3 (as total dust) and 5 mg/m^3 (as respirable fraction) over each 8 hours of a 40 hour work week (OSHA PEL, 1989).

Conditions to Avoid: Generation of airborne dust or mist; contact with incompatible materials at high temperatures; entry or runoff to sewers or water bodies; excessive inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Hazards of public exposures to titanium dioxide in typical spill situations are expected to be minimal.

Hazards of Skin or Eye Contact: Titanium oxide particles are not chemically irritating to the eyes but simply act as common "foreign objects". Some lacrimation, blinking, and mild temporary pain may occur as solid particles are rinsed from the surface of eyes. Rubbing eyes containing solid particles may aggravate irritation. The substance is not irritating to the skin in brief exposures but prolonged or repeated contact may result in mild irritation.

Hazards of Inhalation: Hazard is low if minimal precautions are taken. High concentrations of fairly pure titanium oxide dust in air may at most cause coughing, mild temporary irritation of the nose and throat, and possibly some chest discomfort in brief encounters. Repeated or prolonged exposure to massive concentrations of dust may cause lung injury by blocking blood vessels and distorting the shape of airways.

Hazards of Ingestion: Pure titanium dioxide is reported as being practically non-toxic by ingestion.

FIRE HAZARDS

Lower Flammable Limit: Not combustible

Upper Flammable Limit: Not combustible

Behavior in Fire: Solid titanium is very inert and stable, even in a fire.

Hazardous Combustion Products: None

EXPLOSION HAZARDS

Lower Explosive Limit: Not combustible

Upper Explosive Limit: Not combustible

Explosiveness: See Behavior in Fire section directly above.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Where deemed necessary, equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with significant concentrations of titanium dioxide dust in air. It is considered good practice to wear dust-proof or splash-proof safety goggles (as appropriate) to prevent eye contact and coveralls or long-sleeved shirts and pants to prevent accumulation of titanium dioxide on the skin. Compatible materials are reported as likely to include any material commonly used in protective clothing.

Respiratory Protection: For fire fighting or high concentrations (above 750 mg/m^3 in air), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent), which may also be used for all other levels of exposure. For dusts or mists in air, NIOSH alternatively recommends any dust or mist respirator for concentrations in the range of 10 to 75 mg/m^3 and any dust and mist respirator except single-use or quarter-mask type respirators for concentrations of 150 mg/m^3 or less within the use limitations of these devices. For dust, mist, or fume concentrations in air, NIOSH alternatively recommends any fume respirator or high efficiency particulate filter respirator for concentrations of 150 mg/m^3 or less and a high efficiency particulate filter respirator with a full facepiece for concentrations of 750 mg/m^3 or less within the use limitations of these devices.

TITANIUM DIOXIDE
Non-Regulated

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat or skin.

First Aid for Inhalation: Remove victim to fresh air. In the unlikely event that breathing becomes difficult or stops, administer artificial respiration. Get medical attention immediately if breathing problems are apparent, especially if substances other than titanium dioxide may have been inhaled. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: If irritation occurs, flush eyes with water, occasionally lifting the eyelids, until all particles *of* solid titanium dioxide have been removed. If skin irritation occurs, remove all contaminated clothing. Gently wash affected body areas with large amounts of soap and water. Get medical attention if eye irritation persists after washing.

First Aid for Ingestion: If conscious, have victim rinse mouth out with water and then administer large quantities of water to drink. For incidents involving relatively pure titanium dioxide, do not induce vomiting. Get medical attention if a large amount has been ingested. If the titanium dioxide product contains other substances, attempt to determine what they are, seek medical advice as soon as possible on whether vomiting should be induced, and obtain appropriate medical attention. If vomiting occurs naturally or is induced, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Do not make an unconscious person vomit.

FIRE RESPONSE

Extinguishing Materials: Titanium dioxide is not combustible and is reported as essentially inert in normal fires. Use any extinguishing agent appropriate for the surrounding fire.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk, particularly if the cargo is a slurry of titanium dioxide in water. Use professional judgment to decide if well-sealed containers or tanks of titanium dioxide slurries in water should be kept cool via use of water sprays to avoid the possibility of container rupture due to buildup of steam pressure. If deemed necessary, use water from side and from safe distance to keep such containers cool until well after fire is out. For a massive fire in the cargo area under these circumstances, it may be prudent to use unmanned hose holders or monitor nozzles. In any case, stay away from ends of tanks involved in fire, but realize that shrapnel may travel in any direction.

SPILL RESPONSES

General Information: Keep unprotected personnel away from spill area. Avoid excessive and/or prolonged contact with spilled product. Stop leak if safe to do so. Prevent substance from entering sewers. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Titanium dioxide and its slurries in water will not evolve significant amounts of hazardous airborne contaminants in most spill situations. It may be advisable in such cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Irritating levels of titanium dusts or mists may possibly be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind if necessary.

TITANIUM DIOXIDE
Non-Regulated

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid titanium dioxide with a plastic sheet or other compatible material to prevent airborne dust or contact with water.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Where necessary, water fog or spray applied to titanium dioxide dusts or mists in air may knock them down and accelerate their dispersal in the atmosphere. Apply water at a point downwind if practical if solid titanium dioxide is exposed to prevent spreading of contamination where this may be of concern. Alternatively, consider wetting down the surface of titanium dioxide powder with a gentle water fog to reduce generation of airborne dust.

CONSEQUENCE

Water runoff may contain some amounts of titanium dioxide.

MITIGATION

Contain contaminated water where deemed necessary and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Titanium dioxide, its slurries in water, and/or contaminated water runoff may be contained by building dikes or barriers using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain slurries of titanium dioxide or contaminated water runoff.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged, develop leaks, or possibly react with titanium dioxide under the appropriate conditions. Thick slurries of solid titanium dioxide in water may plug, clog, or cause abrasion damage to equipment.

MITIGATION

Dilute and mix slurry with water prior to recovery by this method where necessary. Use equipment capable of handling slurries and compatible with titanium dioxide as and if necessary. Alternatively, let solids settle and carefully draw off water layer.

TITANIUM DIOXIDE
Non-Regulated

TECHNIQUE

ABSORPTION . . . Spreading of slurries and/or contaminated runoff may be controlled by absorbing the liquid with sand, earth, clay, vermiculite, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of a fire simply on general principles.

TECHNIQUE

MECHANICAL REMOVAL . . . Solid titanium dioxide, its residues, and/or contaminated soil may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may become damaged or corroded, or possibly react with titanium dioxide. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause titanium dioxide dust to become airborne.

MITIGATION

Select removal procedures that do not cause titanium dioxide dust to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid titanium dioxide and particles in slurries will generally sink in water but some fine solid particles may trap air and float for awhile; some may remain suspended in the water column for a time. The product is reported to be of relatively low toxicity to aquatic life but has the potential to physically smother life forms residing on the bottom of a water body.

CONSEQUENCE

Alternative water supplies may be needed to accommodate certain water users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water solids and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

TITANIUM DIOXIDE
Non-Regulated

TECHNIQUE

CONTAINMENT DIKES . . . Water containing suspended titanium dioxide particles may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment (by filtration, clarification, or settling, for example) or for disposal.

September 2006

TITANIUM TETRACHLORIDE

Class 8 (Corrosive Material)

GENERAL INFORMATION

Titanium tetrachloride is a colorless fuming liquid with an acrid, choking, pungent, and irritating odor. It is toxic to humans and the environment. It is used in making pure titanium and its salts, iridescent effects in glass, smoke screens, pigments, and polymerization catalysts. The product is not flammable and weighs approximately 14.4 pounds per gallon.

Titanium tetrachloride will react vigorously with water or moist air to generate heat, hydrochloric acid, titanium dioxide and possibly titanium oxychloride. The liquid product and the dense white fumes evolved in air are highly corrosive to all bodily tissues and will attack many metals when water is present, possibly with the evolution of flammable and potentially explosive hydrogen gas. The product is also highly reactive with a wide variety of other chemicals and substances. Contact with explosives may cause an explosion. There is a limited potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

If titanium tetrachloride is involved in an incident, as an immediate precautionary measure, isolate spill or leak area in all directions for at least 150 feet (50 meters) for liquids and at least 75 feet (25 meters) for solids. In the event titanium tetrachloride is released to the environment, the following evacuation distances should be considered. Note there are different distances for land and water spills due to the reactivity of titanium tetrachloride with water. For **small** spills on ***land***, isolate area for a radius of 100 feet (30 meters) in all directions with a downwind evacuation of 0.1 miles (0.1 kilometers) for daytime and nighttime. For **small** spills in ***water***, isolate area for a radius of 100 feet (30 meters) in all directions with a downwind evacuation of 0.1 miles (0.1 kilometers) for daytime and 0.3 miles (0.5 kilometers) for nighttime. For **large** spills on ***land***, isolate area for a radius of 200 feet (60 meters) in all directions with a downwind evacuation of 0.3 miles (0.5 kilometers) for daytime and 0.5 miles (0.8 kilometers) for nighttime. For **large** spills in ***water***, isolate area for a radius of 400 feet (120 meters) in all directions with a downwind evacuation of 0.7 miles (1.1 kilometers) for daytime and 2.3 miles (3.7 kilometers) for nighttime. These distances should be adjusted when taking into consideration the amount of material spilled, location, local weather conditions and other factors. If a bulk container of titanium tetrachloride is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. Titanium tetrachloride fumes may be heavier than air and collect in low lying areas.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Hydrolyzes
Solubility in Other Chemicals: Soluble in alcohol and dilute hydrochloric acid.
Specific Gravity (Liquid): 1.726 at 68°F (20°C)
Vapor Density: 4.9 – 6.5
Boiling Point: 278°F (136.4°C) at 1 atm.
Melting Point: Unavailable
Freezing Point: –9.8 to –22°F (–23.2 to –30°C)
Molecular Weight: 189.73
Heat of Combustion: Not flammable
Evaporation Rate (butyl acetate=1): Not available
Vapor Pressure: 10 mmHg (0.193 psia) at 70.3°F (21.3°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Flammable Limits: Not flammable
Stability: Stable, but reacts with water or moisture
Polymerization Potential: Will not occur
pH: Not applicable
Corrosiveness: Hydrochloric acid formed in reactions with water is corrosive.
Reactivity with Water: May react vigorously with water or moist air giving off heat with dense white clouds of hydrochloric acid, titanium dioxide and possibly titanium oxychloride.
Reactivity and Incompatibility: Reacts with peroxides, epoxides, explosives, alcohols, reactive metals (sodium, magnesium, potassium, etc.) and a wide variety of other chemicals and substances.

IDENTIFICATION

Shipping Names: Titanium tetrachloride (USDOT & IMO)
Synonyms and Tradenames: Titanium chloride; Tannic chloride; Titanium (IV) chloride; Titanic chloride.
CAS Registry No.: 7550-45-0
Chemical Formula: $TiCl_4$
Constituent Components(% each): Approx. 100% pure
UN/NA Designation: UN1838
IMO Designation: 8, corrosive substances; 6.1 toxic substances
RTECS Number: XR195000
NFPA 704 Hazard Rating: 3 (Health): 0 (Flammability): 2 (Instability): Water reactive
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Colorless to yellow
Odor Characteristics: Acrid, pungent, choking, irritating
Reportable Quantity: See Appendix I
Common Uses: Mfg. of pure titanium and salts, iridescent effects in glass, smoke screens, titanium pigments, and polymerization catalyst.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

TITANIUM TETRACHLORIDE

Class 8 (Corrosive Material)

and

and

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly corrosive and reactive liquid with hazardous fumes. Will react vigorously with water. May evolve hydrogen gas in contact with certain metals when wet. Material is toxic to the environment.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): 0.5 mg/m^3 (Lyondell Millennium Inorganic Chemicals)

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Emergency Response Planning Guidelines (ERPG): 5 mg/m^3 (ERPG-1); 20 mg/m^3 (ERPG-2); 100 mg/m^3 (ERPG-3) (AIHA)

Conditions to Avoid: Heat; contact with incompatible materials, combustible materials such as wood, paper and oils, or water; runoff to sewers or water sources; inhalation, ingestion, and direct physical contact; sparks where hydrogen may be present.

HEALTH HAZARDS

Public Health Hazards: Titanium tetrachloride is highly corrosive to bodily tissues by all routes of exposure. Major hazard to public is inhalation of vapors or fumes in air, but ingestion and direct physical contact are also to be strictly avoided. May be fatal if inhaled.

Hazards of Skin or Eye Contact: Contact of the skin with liquid titanium tetrachloride may cause severe burns. Contact with the eyes may result in permanent eye damage.

Hazards of Inhalation: Vapors and fumes evolved from titanium tetrachloride are irritating and corrosive to the eyes, skin, nose, and throat. Inhalation may cause coughing, headache, dizziness, possible lung damage, and possible bronchial pneumonia with potentially severe consequences or death.

Hazards of Ingestion: Ingestion may result in burns, nausea, vomiting, cramps, diarrhea, and possible tissue ulceration.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: Not flammable

Upper Flammable (Explosive) Limit: Not flammable

Behavior in Fire: Containers may rupture in fire due to overpressurization. May generate large quantities of corrosive vapors and fumes upon release.

Hazardous Combustion Products: Will not burn, but thermal decomposition will generate toxic chlorine gas, hydrogen chloride, titanium oxychloride and titanium oxides.

EXPLOSION HAZARDS

Explosiveness: Very reactive. Not flammable but containers may rupture in fire due to overpressure. Contact with certain other chemicals may result in formation of explosive mixtures. Hydrogen gas evolved in reactions with some metals may explode if ignited in a confined area.

1838

TITANIUM TETRACHLORIDE

Class 8 (Corrosive Material)

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include neoprene, PVC, Saranex® coated Tyvek®, or Viton®. The following materials are reported to have greater than 8 hour breakthrough time: Tychem® BR; Tychem® LV; Tychem® Responder®; Tychem® Responder® CSM; Tychem® TK; Tychem® Reflector®; Tychem® PVC; Tychem® ThermoPro. The following materials are ***not*** recommended for use: Tychem® CPF 2; Tychem® SL; Tychem® CPF 4; butyl rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations: any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode; or any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

FIRST AID

Nonspecific Symptoms: Irritations or burns of any bodily tissues; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of water for at least 20 minutes. Get medical attention immediately. (Note: Wipe titanium tetrachloride off skin with dry cloth before applying water. This will reduce potential for severe burns due to reaction with water.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Get medical attention immediately. (Note: Wipe titanium tetrachloride off eyes with dry cloth before applying water. This will reduce potential for severe burns due to reaction with water.)

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. Do not give sodium bicarbonate (baking soda) or other carbonates.

Note to Physician: Titanium tetrachloride reacts with moisture to form hydrochloric acid, both of which are corrosive to all body tissues and will produce chemical and thermal burns. Ingestion may result in delayed development of esophageal or gastric strictures.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide or flooding water. Product reacts with water or foam but may consider using large amounts of water fog or spray if large quantities of combustibles are involved.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Note that addition of water may increase evolution of fumes from leaking product. If using water, use in flooding quantities.

TITANIUM TETRACHLORIDE
Class 8 (Corrosive Material)

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area and determine area for evacuation. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or damage of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Take into account the reactivity of product with many common metals when deciding on the appropriate response and equipment. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Consult a qualified specialist on neutralization techniques. However, some sources suggest neutralizing run-off with slacked lime, soda ash or crushed limestone. Use explosion-proof and spark-proof equipment where necessary. Do not use combustible materials, such as sawdust. Titanium tetrachloride is highly reactive with water. Take into account while planning the response that it is highly corrosive and toxic with heavier than air vapors that may persist for a time in low areas.

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to titanium tetrachloride vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill and should not be allowed to contact pools of titanium tetrachloride.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain titanium tetrachloride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . There is a possibility that foam applied to the surface of liquid pools may slow the release of titanium tetrachloride vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

TITANIUM TETRACHLORIDE

Class 8 (Corrosive Material)

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid titanium tetrachloride may slow the release of vapors into the atmosphere. The response is better suited to smaller spills and entails special risks.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Vapor or fume evolution may be vastly increased during and immediately after water application, thus increasing downwind and local hazards for a time.

MITIGATION

Contain spilled product and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Some possibilities include knockdown of vapors or fumes via water fog or spray and temporary evacuation of downwind populations and other vulnerable resources. Proceed with caution. Consult qualified experts.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent to liquid titanium tetrachloride may eventually slow the release of vapors or fumes into the atmosphere. Possible neutralization agents may include, agricultural lime, slaked lime, crushed limestone, sodium hydroxide or soda ash.

CONSEQUENCE

Depending on the neutralization agent and application technique used, the resulting chemical reaction may produce varying amounts of heat, vapors, fumes and spattering.

MITIGATION

Proceed with caution. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Titanium tetrachloride may be contained by building dikes using soil, dry sand or other materials.

CONSEQUENCE

Contained titanium tetrachloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TITANIUM TETRACHLORIDE

Class 8 (Corrosive Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. Possible neutralization agents may include, agricultural lime, slaked lime, crushed limestone, sodium hydroxide or soda ash.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards. Possible neutralization agents may include, agricultural lime, slaked lime, crushed limestone, sodium hydroxide or soda ash applied after the reaction subsides.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks and may need special approval from regulatory agencies.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consider treating water using a processing system constructed on land.

September 2006

TOLUENE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Toluene is a clear, colorless aromatic hydrocarbon liquid that occurs naturally in crude oil and in the tolu tree. It has a pungent pleasant odor resembling benzene or model glue. It is used as a solvent, is a common component of hydrocarbon fuels, and is a raw material for making explosives, dyes, benzene, and various other organic chemicals. It is barely soluble in water and lighter, so it may be expected to form a floating surface slick that dissolves at a very slow rate. Its flash point of 40°F indicates that the product can be easily ignited under a wide variety of ambient temperature conditions. Vapors are somewhat heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers have some limited potential to rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 7.2 pounds per gallon.

Toluene does not react with water or many other common materials and is stable in normal transportation. It is primarily incompatible with strong oxidizers that may cause its ignition. Although it is relatively noncorrosive to most metals, the liquid may attack some forms of plastics, rubber and coatings. Toxicity is low to moderate via the various potential routes of exposure. Products of combustion may include toxic constituents.

If toluene is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Barely soluble, 0.05 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetic acid, acetone, alcohol, benzene, ether, ligroin, chloroform, carbon disulfide and other hydrocarbons.

Specific Gravity (Liquid): 0.867 at 68°F (20°C)

Vapor Density: 3.14

Boiling Point: 231.1°F (110.6°C) at 1 atm.

Melting Point: –139°F (–95°C)

Freezing Point: –139°F (–95°C)

Molecular Weight: 92.14

Heat of Combustion: –9686 cal/g

Evaporation Rate (butyl acetate=1): 2.24

Vapor Pressure: 22 mmHg (0.425 psia) at 68°F (20°C)

Flash Point: 40°F (4.4°C), closed cup; 55°F (12.8°C), open cup.

Autoignition Temperature: Reports vary 792°F – 997°F (422°C – 536°C)

Burning Rate: 5.7 mm/minute

Flammable (Explosive) Limits: 1.1% (LEL) – 7.1% (UEL) one source reports 3.3% – 19%

Stability: Stable

Polymerization Potential: Will not occur

pH: Not applicable

Corrosiveness: May attack some plastics, rubber, and coatings; noncorrosive to most metals.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with strong oxidizing materials, halogens or molten sulphur. Toluene forms explosive reactions with nitric acid, especially sulfuric acid, 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; N_2O_4; $AgClO_4$; BrF_3; uranium hexafluoride; sulfur dichloride and tetranitromethane.

IDENTIFICATION

Shipping Names: Toluene (USDOT & IMO)

Synonyms and Tradenames: Methylbenzene; Methylbenzol; Phenylmethane; Toluol; Methacide; Antisal 1A; CP 25; Methacide; NCI-C07272; Tolu-sol

CAS Registry No.: 108-88-3

Chemical Formula: $C_6H_5CH_3$

Constituent Components (% each): 94% or more pure (typically) with remainder xylene, some benzene, and other hydrocarbons.

UN/NA Designation: UN1294

IMO Designation: 3, flammable liquids

RTECS Number: XS5250000

NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 0 (Instability)

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Pungent, pleasant, aromatic, like benzene or model glue.

Reportable Quantity: See Appendix I

Common Uses: Solvent in paints, coatings, lacquers, paint thinners, fingernail polish, lacquers, adhesives, rubber, and other products; hydrocarbon fuel component; mfg. of explosives, dyes, benzene, and other organic chemicals. Some printing and leather tanning processes toluene is a major component of JP-8 fuel.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

TOLUENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.17 – 40 ppm; reported values vary, but most fall within 0.2 – 5ppm.

Unusual Hazards: Somewhat volatile flammable hydrocarbon with heavier than air vapors that may travel to a source of ignition and flash back. Flowing product may be ignited by self-generated static electricity.

Short Term Exposure Limits (STEL): 150 ppm (560 mg/m^3) (NIOSH)

Time Weighted Average (TLV-TWA): 100 ppm (375 mg/m^3) (NIOSH); 200 ppm (OSHA)

Ceiling (C) Limit: 300 ppm (OSHA)

IDLH: 500 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations that may be present in the spill area and immediately downwind. Ingestion and direct contact should also be avoided. Be alert to hazards of any benzene (see separate guide) that may be present.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid toluene may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Some amount may be absorbed through the skin. Contact with the eyes may cause irritation and temporary corneal injury.

Hazards of Inhalation: Vapors of toluene may cause coughing, sore throat, irritation of the eyes, mucous membranes, and upper respiratory tract. High concentrations may cause narcosis and central nervous system depression with symptoms including fatigue, weakness, confusion, headache, dizziness, drowsiness, incoordination, peculiar skin sensation or numbness, unconsciousness, and possibly death.

Hazards of Ingestion: Ingestion in significant amounts may result in burning sensation, vomiting, diarrhea, griping, depressed respiration, and possibly death. Aspiration into the lungs during vomiting may cause gagging, coughing, respiratory distress, and rapidly developing pulmonary edema with possibly severe consequences.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 1.1%; one source reports 3.3%

Upper Flammable (Explosive) Limit: 7.1%; one source reports 19%

Behavior in Fire: Flammable liquid. There is some limited potential that containers may rupture violently in fire. May generate significant quantities of flammable vapors upon release. Vapors may be heavier than air and may travel to a source of ignition and flash back.

Hazardous Decomposition Products: Toxic gases, such as carbon dioxide and carbon monoxide, may be released. Contact with nitric and sulfuric acids may form nitrocresols that can decompose violently.

EXPLOSION HAZARDS

Explosive Potential: There is some limited potential that containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

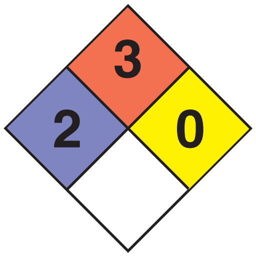
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include polyurethane, nitrile-butadiene rubber, Saranex®, and fluorine/chloroprene. The following materials are reported to have a breakthrough time greater than 8 hours: Tychem® CPF 3; Tychem® CPF 4; Tychem® BR; Tychem® LV; Tychem® Responder®; Tychem® Responder® CSM; Tychem® TK; Tychem® F; Tychem® Reflector®; Tychem® ThermoPro; polyvinyl alcohol; Viton®; Barricade®; Trellchem® HPS suits; CPF3®; Teflon®; 4H® and Silver Shield® brand gloves; Viton®890 gloves. The following materials are ***not*** recommended: neoprene; latex or rubber; butyl or nitrile latex; Tychem® CPF 1; Tychem® QC; Tychem® CPF 2; Tychem® SL; Tychem® PVC; Tychem® Butyl.

1294

TOLUENE

Class 3 (Flammable Liquid)



Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 500 ppm): a self-contained breathing apparatus (SCBA) with full facepiece; any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 500 ppm): any air-purifying half-mask respirator equipped with organic vapor cartridge(s); any powered air-purifying respirator with organic vapor cartridge(s); any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; any supplied-air respirator; any self-contained breathing apparatus with a full facepiece. NOTE: In certain cases, eye protection may be required in addition to the respirator.

FIRST AID

Nonspecific Symptoms: May cause redness and inflammation of the eyes and eyelids, runny nose, scratchy throat, fatigue, weakness, incoordination, confusion, headache, dizziness, and drowsiness.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of water for 15 minutes, followed by washing with soap and water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Most sources recommend administering large quantities of water, however one source reports *not* to administer water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, and water spray or fog.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Consider wearing full chemical protective suit if contact with material or dense fumes/smoke anticipated. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Toluene may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases. Note that toluene has a flash point of 40°F.

SPILL RESPONSES

General Information: Toluene is a highly flammable and volatile liquid that may cause environmental contamination. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Take into account while planning the response that toluene has limited solubility in water and may float.

TOLUENE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Toluene may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of toluene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to toluene vapors or fumes may accelerate their dispersal in the atmosphere. Toluene may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Water runoff may contain a small amount (if any) of toluene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of toluene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Toluene may be contained by building dikes or barriers using soil, sand or other non-combustible materials.

CONSEQUENCE

Contained toluene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TOLUENE
Class 3 (Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, fly ash, cement powder, vermiculite, fullers earth or other absorbent, non-combustible and compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves, current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TOLUENE

Class 3 (Flammable Liquid)

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating toluene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with toluene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

TOLUENE DIISOCYANATE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Toluene diisocyanate is a colorless to pale yellow liquid or solid with a sweet, pungent, and fruity odor. It is used to make polyurethane foams, plastics, paints, adhesives, and coatings. It is heavier than water and reacts nonviolently to form carbon dioxide gas and insoluble polyureas. Its flash point of 270°F indicates that the product must be heated before ignition may easily occur. The product weighs approximately 10.2 pounds per gallon and has a freezing point of 68-72°F.

Toluene diisocyanate is stable in normal transportation and does not react with many common materials besides water. It may slowly self-polymerize in a non-hazardous fashion above 113°F, and is reactive with various chemicals. Toxicity should be considered high by all routes of exposure due to special hazards described in the following. Products of combustion may include toxic cyanides, oxides of nitrogen, and highly irritating vapors, but these products may actually pose less of an air pollution hazard at times than the unburned chemical.

If toluene diisocyanate is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard, especially if large amounts have spilled or the product is somehow heated.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts; see below

Solubility in Other Chemicals: Data unavailable

Specific Gravity (Liquid): 1.22 at 77°F (25°C)

Boiling Point: 482°F (250°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: 68-72°F (20-22.2°C)

Molecular Weight: 174.16

Heat of Combustion: – 5720 cal/g

Vapor Pressure: 0.038 mm Hg (0.0007 psia) at 59°F(15°C)

Flash Point: 270°F (132.2°C), open cup

Autoignition Temperature: Over 300°F (148.9°C)

Burning Rate: Unavailable

Stability: Stable, but slowly polymerizes above 113°F (45°C) .

Corrosiveness: Avoid copper and its alloys and polyurethane.

Reactivity with Water: Reacts nonviolently with heat evolution to form carbon dioxide and insoluble polyureas that are relatively nontoxic and inert.

Reactivity with Other Chemicals: Reacts violently with amines, alcohols, and acids. Also reacts with aniline, ammonia, strong oxidizers, and bases.

IDENTIFICATION

Shipping Names: Toluene diisocyanate (USDOT and IMO)

Synonyms and Tradenames: 1,3-Diisocyanatomethylbenzene; isocyanic acid, methyl-m-phenylene ester or methylphenylene ester; diisocyanatotoluene; tolylene isocyanate; toluene-2,4-diisocyanate; 2,4-toluene diisocyanate; Hylene T; Mondur TDS; Nacconate 100; methylphenylene isocyanate; tolylene diisocyanate; TDI.

Chemical Formula: $2,4\text{-}CH_3C_6H_3(NCO)_2$

Constituent Components(% each): 99% total diisocyanate; may contain large fraction of similar 2,6-isomer.

UN/NA Designation: UN2078

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid or solid (solidifies at 68-72°F)

Color of the Shipped Material: Colorless to pale yellow

Odor Characteristics: Sweet, fruity, pungent; like chloroform

Common Uses: Mfg. polyurethane foams, plastics, paints, adhesives, and coatings.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

TOLUENE DIISOCYANATE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.049 ppm

Unusual Hazards: Highly toxic substance with special hazards.

Short Term Exposure Limits(STEL): 0.020 ppm for 15 minutes. (ACGIH)

Time Weighted Average(TLV-TWA): 0.005 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat or fire; contact with incompatible materials; entry to water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Although the product is of low volatility, even very low concentrations in air are capable of causing toxic effects. Some people may be sensitized such that any further exposure causes a severe reaction.

Hazards of Skin or Eye Contact: Prolonged contact of the skin with toluene diisocyanate may cause redness, swelling, and blistering with occasional skin sensitization. Contact with the eyes may result in severe irritation, pain, lacrimation, swelling of the lids, and mild damage to the corneal epithelium. Severe iridocyclitis, sensitivity to light, blepharospasm, and secondary glaucoma are also possible.

Hazards of Inhalation: Vapors of toluene diisocyanate cause irritation of the eyes, nose, and throat, a choking sensation, coughing, and chest pain. Concentrations above 0.5 ppm in air may cause pressure in the chest, bronchitis, severe bronchospasm, pulmonary edema, nausea, vomiting, and abdominal pain. Some effects may be delayed in onset. The respiratory system may be sensitized such that any further exposure causes a severe asthmatic reaction that may be delayed and could be fatal. Eye and nose irritation may occur at levels as low as 0.05-0.1 ppm in air.

Hazards of Ingestion: Ingestion may result in burns of the mouth and stomach. Oral toxicity is otherwise low.

FIRE HAZARDS

Lower Flammable Limit: 0.9%

Upper Flammable Limit: 9.5%

Behavior in Fire: Will burn but difficult to ignite. There is an uncertain possibility of violent container rupture in fires.

Hazardous Combustion Products: May include toxic cyanides, oxides of nitrogen, and other irritating gases. These products may actually pose less of an overall air pollution hazard at times than the unburned chemical.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors from hot liquid are ignited in a confined area. There is an uncertain possibility of violent container rupture in fires. Reaction with water may develop high pressures in sealed containers.

PROTECTIVE CLOTHING AND EQUIPMENT

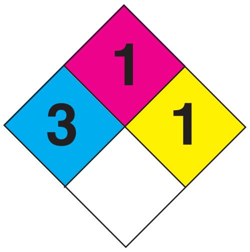
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Compatible materials may include butyl rubber, natural rubber, polyethylene, chlorinated polyethylene, and polyvinyl alcohol.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 0.020 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2078

TOLUENE DIISOCYANATE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, or respiratory system; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Note that water or foam may cause frothing.

Extinguishing Techniques: Unusual toxic vapor or fume hazard. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the special toxic hazards of toluene diisocyanate into account while planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Toluene diisocyanate spills may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to toluene diisocyanate vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of toluene diisocyanate from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TOLUENE DIISOCYANATE

Division 6.1 (Poisonous Material)

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere and react with toluene diisocyanate to form less hazardous products.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Toluene diisocyanate may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained toluene diisocyanate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Product may solidify and plug equipment.

MITIGATION

Use equipment compatible with spilled product. Use alternative method in cool weather.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TOLUENE DIISOCYANATE
Division 6.1 (Poisonous Material)

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance. (Note: Toluene diisocyanate may be reacted with water to form less toxic substances. Small amounts of isopropanol and ammonia speed the reaction. The chemical should be added to water. Exposure to the atmosphere should be minimized.)

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation of solid product may cause dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation from solid product.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. (Note: Toluene diisocyanate reacts with water to form relatively inert and nontoxic substances. There may be cases, however, when the chemical has not fully reacted before entering downstream water intakes.)

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water and form insoluble solid polyureas. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air and if the toluene diisocyanate has not fully reacted.

MITIGATION

Consult qualified experts for guidance.

September 2003

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

2,4-Toluylenediamine is a colorless to brown needle-shaped crystal or powder with a slight odor, possibly resembling ammonia. It is soluble in water as well as benzene, ethanol, acetone ether and aqueous sodium carbonate. It is a suspected human carcinogen and can be absorbed through the skin, thereby increasing exposure. Main routes of entry are inhalation of airborne dust or absorption through the skin. It is used as an intermediate in making polyurethanes and dyes and also as a dye for furs, textiles and hair. Although the substance is not itself flammable, it may support combustion and will produce poisonous gases in fire, including carbon monoxide and nitrogen oxides. It has a high melting point of 210°F at which point it transitions to the molten state. 2,4-Toluylenediamine reacts with acids, acid chlorides, acid anhydrides, chloroformates and strong oxidizing agents. Product oxidizes in air. It is stable under normal pressures and temperatures and will not polymerize. The product weighs approximately 8.7 pounds per gallon.

Initial downwind evacuation should be considered if a spill of 2,4-toluylenediamine is generating large amounts of dust or fumes. If container of 2,4-toluylenediamine is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) in all directions mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 50g/l
Solubility in Other Chemicals: Soluble in benzene, ethanol, acetone ether and aqueous sodium carbonate.
Specific Gravity (Liquid): 1.047 at 212°F (100°C)
Vapor Density: Unavailable
Boiling Point: 558°F (292°C)
Melting Point: 210°F (99°C)
Freezing Point: See melting point
Molecular Weight: 122.17
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): Unavailable
Vapor Pressure: 1 mm Hg at 107°F (42°C)
Flash Point: 300°F (149°C)
Autoignition Temperature: 689°F (365°C)
Burning Rate: Unavailable
Flammable Limits: Unavailable
Stability: Stable under normal temperatures and pressures
Polymerization Potential: Will not occur
pH: 9.5 to 10.5
Reactivity and Incompatibility: Reacts with acids, acid chlorides, acid anhydrides, chloroformates and strong oxidizing agents. Product oxidizes in air and is in molten state between 212°F and 302°F.

IDENTIFICATION

Shipping Name(s): 2,4-Toluylenediamine or 2,4-Toluenediamine (USDOT); 2,4-Toluylenediamine, liquid (IMO)
Synonyms and Tradenames: 2,4-Diaminotoluene; 1,3-Diamino-4-methylbenzene; 2,4-Diamino-1-methylbenzene; 2,4-Diamino-1-toluene; 2,4-Diaminotoluol; 3-Amino-p-toluidine; 4-Methyl-1,3-benzenediamine; 4-Methyl-m-phenylenediamine; 4-Methylphenylene-1,3-diamine; 5-Amino-o-toluidine; Azogen developer h; Benzofur mt; Diaminotoluene, 2,4-; C.I. 76035; C.I. oxidation base; C.I. oxidation base 20; C.I. oxidation base 200; C.I. oxidation base 35; Developer 14; Developer b; Developer db; Developer dbj; Developer mc; Developer mt; Developer mt-cf; Developer mtd; Developer t; Eucanine gb; Fouramine; Fouramine j; Fourrine 94; Fourrine m; MTD; Nako tmt; Pelagol grey j; Pelagol j; Pontamine developer tn; Renal md; Toluene-2,4-Diamine; Toluenediamine; Tolylene-2,4-diamine; Tertral g; Zoba gke; Zogen developer h
CAS Registry No.: 95-80-7
Chemical Formula: $C_7H_{10}N_2$
Constituent Components (% each): 98% or more pure
UN/NA Designation: UN1709
IMO Designation: 6.1, Toxic substances
RTECS Number: XS9625000
NFPA 704 Hazard Rating: 2 (Health): 0 (Flammability): 0 (Reactivity) (Estimated)
Physical Form as Shipped: Solid, flakes or crystals
Physical Form as Released: Solid, flakes or crystals
Color of the Shipped Material: Light brown flakes, may also be colorless
Odor Characteristics: Slight odor, possibly faintly like ammonia
Reportable Quantity: See appendix I
Common Uses: A hair, fur and textile dye ingredient; An intermediate in making polyurethanes and dyes.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Product is highly toxic and a suspected carcinogen. Toxic fumes of nitrogen oxides and carbon monoxide may be produced in a fire.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Dust generation; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: 2,4-Toluylenediamine is irritative to bodily tissues by all routes of exposure. Major hazard to public is inhalation of dust or vapors in air but ingestion and direct physical contact are also to be strictly avoided. Product is a suspected carcinogen.

Hazards of Skin or Eye Contact: Causes eye and skin irritation. May cause severe inflammation and edema of the eye and conjunctiva or deeper structures of the eye, inflammation of the eyelids, keratoconjunctivitis, corneal opacity, tearing or permanent blindness. May cause skin sensitization, allergic reaction, severe dermatitis or hives. If absorbed, may cause symptoms similar to those for ingestion. May cause a deep staining of the skin.

Hazards of Inhalation: Inhalation may cause asthma and shortness of breath or effects similar to those described for ingestion.

Hazards of Ingestion: Ingestion may cause irritation of the digestive tract, gastritis, methemoglobinemia, cyanosis (bluish discoloration of skin due to deficient oxygenation of the blood), convulsions, tremors, coma or death. Methemoglobinemia is characterized by dizziness, drowsiness, headache, breath shortness, cyanosis with bluish skin, rapid heart rate and chocolate-brown colored blood.

FIRE HAZARDS

Lower Flammable Limit: Unavailable

Upper Flammable Limit: Unavailable

Behavior in Fire: Material supports combustion. Containers may rupture violently in fire.

Hazardous Combustion Products: Nitrogen oxides, carbon monoxide, carbon dioxide and nitrogen.

EXPLOSION HAZARDS

Explosive Potential: Containers may rupture violently in fire. As with all organic dust material, there is a possibility of explosions from the airborne dust.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

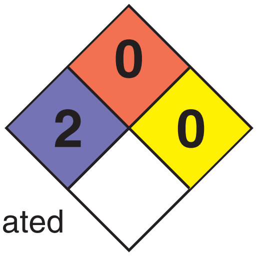
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or dust concentrations in air.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister or a supplied-air respirator with eye protection may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are within the acceptable levels for their use. Protection provided by air purifying respirators is limited.

1709

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)



Estimated

FIRST AID

Nonspecific Symptoms: Irritation or sensitivity of any bodily tissues. May cause asthma or shortness of breath or discoloration of skin.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult, give oxygen. If breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Consult medical personnel regarding whether or not to induce vomiting. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Dry chemical, carbon dioxide, water spray, fog or regular foam.

Extinguishing Techniques: Secure ignition sources in the immediate spill area and down wind. Approach fire from upwind to avoid hazardous vapors, dust and toxic decomposition products. Avoid all bodily contact. Wear appropriate level of personal protective clothing and equipment. Wear chemical vapor protective clothing if contact with material or dense fumes/smoke anticipated. Use water to protect exposures or prevent containers from failing. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. Move container from fire area if no risk. Be alert to container rupture potential. Dike fire control water for proper disposal since it may contain toxic material.

SPILL RESPONSES

General Information: 2,4-Toluylenediamine is a highly toxic solid that may cause environmental contamination. Secure potential sources of heat, sparks, flame, impact, friction and electricity in the immediate spill area and downwind. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Prevent substance from entering sewers and waterways. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Runoff may be toxic. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . 2,4-Toluylenediamine may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed.

CONSEQUENCE

Hazardous levels of vapors in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind to unprotected personnel. Continually monitor for any conditions that would alter the situation.

TECHNIQUE

SHELTERING IN PLACE . . . Depending on the size, type and duration of the spill, it may be advisable to shelter in place instead of evacuation. This technique is best suited for spills that are of short duration and allows for emergency management personnel to plan and execute an evacuation strategy in the event that evacuation is needed. Persons in the spill area should be directed to seek the closest shelter that can be secured (close doors and windows and shut down HVAC systems) and preferably has communications devices, such as phones or TV's, to advise people when it is safe to leave the shelter.

CONSEQUENCE

Sheltered persons may need to be evacuated if conditions are no longer suitable to shelter in place.

MITIGATION

Stop spill or leak and remove the spilled product as soon as possible. Develop a plan to conduct a safe evacuation. Seek expert advice in planning an evacuation strategy.

TECHNIQUE

EVACUATION . . . If conditions are not suitable for sheltering in place, evacuate local and downwind areas to prevent exposure and to allow vapors or fumes to dissipate. Product may expose downwind areas to toxic concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

PROTECTION FROM THE WIND . . . If necessary, cover solid with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may absorb vapors, knockdown fumes and accelerate their dispersal in the atmosphere. Water should not be applied directly onto the product when using dispersing techniques.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)

TECHNIQUE

BURIAL . . . Under appropriate conditions, product may be temporarily buried under a sufficient layer of dry sand, earth or similar material to retard escape of dust or fumes.

CONSEQUENCE

An additional quantity of sand, earth or similar material will become contaminated.

MITIGATION

Consult qualified experts.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Product may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined material may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Apply this technique only to remove final traces of spilled product.

2,4-TOLUYLENEDIAMINE

Division 6.1 (Poisonous Materials)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TRICHLOROBENZENES, LIQUID

Division 6.1 (Poisonous Materials)

GENERAL INFORMATION

Trichlorobenzene is a colorless liquid with a sweet, chloroform-like odor. It is used as a carrier to apply dyes to polyester materials, a heat transfer medium, a degreaser, a solvent and a lubricant. It also functions as a termite pesticide and an aquatic herbicide. Trichlorobenzene is almost completely insoluble in water. Trichlorobenzene in many cases is a mixture of the 1,2,4 and 1,2,5 isomers, but can also include the 1,3,4 and 1,3,5 isomers. For the purposes of this guide the more common 1,2,4 isomer is predominately covered herein. The use of chlorinated hydrocarbon solvents, of which trichlorobenzene is one, is being phased out due to more stringent environmental standards. The lowest reported flash point of 222ºF indicates the product must be heated before ignition may occur. Trichlorobenzene evaporates slowly when exposed to air. There is a possibility that containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration. The product weighs approximately 12.1 pounds per gallon.

Trichlorobenzene is stable in normal transportation and is incompatible with acids, acid fumes and oxidizers. Sources do not report it having a reaction with water. Liquid product may solidify around 63ºF. The toxicity hazards of the product are considerable by all routes of exposure and primarily derive from the highly irritating nature of the substance. The products of combustion may include toxic and irritating constituents of carbon monoxide, hydrogen chloride, chlorine and other toxic vapors.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Almost completely insoluble (0.003%)
Solubility in Other Chemicals: Methanol.
Specific Gravity (Liquid): 1.45
Vapor Density: 6.26
Boiling Point: 416ºF (213ºC)
Melting Point: See freezing point
Freezing Point: 63ºF (17ºC)
Molecular Weight: 181.4
Heat of Combustion: Unavailable
Evaporation Rate (butyl acetate=1): Unavailable
Vapor Pressure: 1 mmHg
Flash Point: 222ºF (105ºC)
Autoignition Temperature: 1060ºF (571ºC)
Burning Rate: Unavailable
Flammable Limits: 2.5% (LEL) - 6.6% (UEL)
pH: Unavailable
Stability: Stable
Polymerization Potential: Will not occur.
Corrosiveness: None reported.
Reactivity with Water: No reaction reported.
Reactivity and Incompatibility: Acids, acid fumes, oxidizers.

IDENTIFICATION

Shipping Name(s): Trichlorobenzenes, liquid (USDOT & IMO)
Synonyms and Tradenames: 1,2,4-Trichlorobenzene; 1,2,3-Trichlorobenzene; unsym-Trichlorobenzene; 1,2,4-Trichlorobenzol; TCB.
CAS Registry No.: 120-82-1 (1,2,4-Trichlorobenzene); 87-61-6 (1,2,3-Trichlorobenzene)
Chemical Formula: $C_6H_3Cl_3$
Constituent Components (% each): Liquid is reported to be close to 100% pure with the variations being isomers of trichlorobenzene.
UN/NA Designation: UN2321
IMO Designation: 6.1, Toxic substances
RTECS Number: DC2100000
NFPA 704 Hazard Rating: 2(Health): 1(Flammability): 0(Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid; product may solidify around 63ºF
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet chloroform-like odor.
Reportable Quantity: See appendix I.
Common Uses: Used as a carrier to apply dyes to polyester materials, a heat transfer medium, a degreaser, a solvent and a lubricant. It also functions as a termite pesticide and an aquatic herbicide.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

TRICHLOROBENZENES, LIQUID

Division 6.1 (Poisonous Materials)

or

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.88-2.4 ppm; another source reports 3 ppm.
Unusual Hazards: Toxic to the environment.
Short Term Exposure Limit (STEL): Unavailable
Time Weighted Average (TLV-TWA): Unavailable
Ceiling (C) Limit: 5 ppm (40 mg/m^3)
IDLH: Unavailable
Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the immediate spill area and downwind. Direct contact and ingestion are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact with the skin may cause severe irritation or burns. Contact of the liquid with eyes has the potential to cause severe injury and burns.

Hazards of Inhalation: Inhalation may cause irritation of the respiratory tract (nose, throat, lungs) with symptoms of coughing, sneezing, and sore throat. Higher concentrations may cause shortness of breath, dullness, narcosis, and pulmonary edema.

Hazards of Ingestion: Ingestion may cause headache, severe gastrointestinal irritation, sore throat, abdominal pain, vomiting, central nervous system stimulation, liver and kidney damage, unconsciousness and possibly death.

FIRE HAZARDS

Lower Flammable Limit: 2.5%
Upper Flammable Limit: 6.6%
Behavior in Fire: The fire hazard is low due to its high flash point but exposure to fire conditions may cause it to ignite. Exposure of containers to fire or heat may result in container rupture.
Hazardous Combustion Products: Combustion can generate carbon monoxide, hydrogen chloride, chlorine and other toxic vapors.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPEMENT

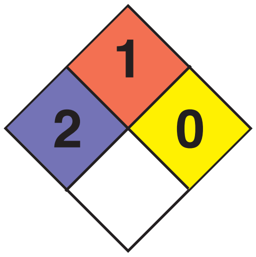
Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof and gas tight safety goggles, and other impervious and resistant clothing. Teflon® is reported to provide more than 8 hours of protection. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary in some cases according to some authorities to prevent contact with high vapor or fume concentrations in air.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece. For lesser concentrations, an air purifying respirator (APR) with organic vapor cartridge with a full facepiece within the use limitations of these devices.

2321

TRICHLOROBENZENES, LIQUID

Division 6.1 (Poisonous Materials)



FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues or eyes and other symptoms of exposure. Ingestion of a few ounces could be fatal to humans.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: In case of skin contact, remove contaminated clothing and wash skin with plenty of soap and water until all traces of material are gone. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart in order to rinse entire surface of eye and lids with water. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Do not attempt to make the victim vomit. Get medical attention immediately. (Note: Authorities disagree on whether or not vomiting should be induced, probably due to the possibility that aspiration into the lungs during vomiting may lead to pulmonary edema or other injury. Seek immediate medical advice on this issue where possible.)

FIRE RESPONSE

Extinguishing Agents: Water spray or fog, dry chemical, carbon dioxide, alcohol type concentrate foam.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to container rupture potential. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Use intrinsically safe tools and equipment where necessary. Note that liquid may solidify around 63ºF.

AIR RELEASE

TECHNIQUE

MONITOR THE SITUATION . . . The product may not produce large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed by product and container specialists.

CONSEQUENCE

Hazardous levels of product in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TRICHLOROBENZENES, LIQUID

Division 6.1 (Poisonous Materials)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vapors or fumes may knock down vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain a small amount (if any) of product from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL TYPE CONCENTRATE FOAM . . . There is a possibility that alcohol type concentrate foam applied to the surface of liquid pools may slow the release of vapors into the atmosphere. The fact that alcohol type concentrate foam is recommended for firefighting indicates it may have value in suppressing vapor evolution.

CONSEQUENCE

The effects of the foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain foam runoff and treat as hazardous waste.

TECHNIQUE

PROTECTION FROM THE WIND . . . If liquid has solidified, it may be advisable to cover solid product with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Decontaminate cover or treat as hazardous waste for disposal.

LAND SPILL

TECHNIQUE

CONFINEMENT DIKES . . . Trichlorobenzene may be confined by building dikes using soil, sand or other materials.

CONSEQUENCE

Confined product may percolate into soil or seep through dike material. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove or neutralize confined product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundmentsWhere possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of confined product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, confinement areas should be lined with suitable, impervious material to prevent penetration into soil.

TRICHLOROBENZENES, LIQUID
Division 6.1 (Poisonous Materials)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material confined in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded. (Note: Liquid may solidify around 63ºF.)

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of solution may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel. Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment. Continually monitor for presence of flammable vapors.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may spread contaminate.

MITIGATION

Excavate as last resort, unless adverse environmental impacts can be minimized.

TRICHLOROBENZENES, LIQUID

Division 6.1 (Poisonous Materials)

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottoms sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent material may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered absorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with the same amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and developing necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

October 1993

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

GENERAL INFORMATION

1,1,1-Trichloroethane is a colorless and moderately volatile liquid with an odor variably described as sweetish, mild, like chloroform or ether, and irritating at higher concentrations. It is practically insoluble in water and heavier, so may be expected to sink and then dissolve at very slow rates. Accumulations of vapors may flash or possibly explode if they encounter a suitable source of ignition in confined spaces such as buildings or sewers. The product weighs about 11.2 pounds per gallon. Commercial grades normally contain one or more inhibitors or stabilizers intended to reduce the potential for corrosion or hazardous reactions.

It is stable in normal transportation when in an undamaged closed container not overly exposed to heat or fire, but otherwise has several unusual characteristics and related hazards. The toxic hazard of the pure substance is generally low to moderate by direct contact and ingestion but very high via inhalation. Products of combustion or thermal decomposition are reported to include irritating, corrosive, toxic, and/or poisonous substances such as hydrogen chloride, hydrochloric acid, carbon monoxide, carbon dioxide, dichloroacetylene, chlorine, phosgene, and possibly other harmful substances.

Downwind evacuation or an alternative protective action should be considered based on the amount of material released, location, weather conditions, and whether or not the product is burning or thermally decomposing if 1,1,1-trichloroethane is leaking from its container. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, an evacuation radius of one-half (1/2) mile will be necessary just for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble.

Solubility in Other Chemicals: Soluble in acetone, benzene, carbon tetrachloride, chloroform, ether, ethanol, and methanol.

Specific Gravity (Liquid): 1.34 - 1.35 at 68°F (20°C).

Boiling Point: 159.8 - 177.8°F (71°C - 81°C).

Melting Point: - 27.4 - 22°F (-33 - 30°C).

Freezing Point: See melting point.

Molecular Weight: 133.41.

Heat of Combustion: - 1,745 cal/g.

Vapor Pressure: 100 mm Hg (1.933 psia) at 68°F (20°C); and 200 mm Hg (3.866 psia) at 97.2°F (36.2°C).

Flash Point: No flash point but can ignite under appropriate conditions of elevated temperature, elevated pressure, and/or presence of a high intensity source of ignition.

Autoignition Temperature: 932°F (500°C) or 999°F (537°C).

Burning Rate: 2.9 mm/minute (est.).

Stability: Stable in normal transportation. Can be decomposed by ultraviolet radiation (sunlight), contact with hot metals, and very high temperatures to form corrosive hydrogen chloride and/or hydrochloric acid, phosgene gas, and dichloroacetylene.

Corrosiveness: Uninhibited or unstabilized grades readily corrode and may react with aluminum and its alloys (see below) but the product may be used with aluminum and many other common materials when inhibited. One authority notes that any hydrogen chloride or hydrochloric acid formed by decomposition (see "Stability" above) or reaction may corrode some metals while evolving flammable and potentially explosive hydrogen gas. The liquid is reported to attack some forms of plastics, rubber, and coatings. Specifically recommended compatible materials include steel, stainless steel, and Teflon.

Reactivity with Water: Reacts slowly. Major end product is vinylidene chloride at 50°F (10°C) according to one source which also says that acetic acid and hydrochloric acid are formed at 77°F (25°C).

Reactivity with Other Chemicals: Highly shock-sensitive explosive materials may be formed by contact with nitrogen tetroxide, potassium or its alloys, potassium-sodium alloy, barium shavings, or lithium. Vapors may react violently with Co/Mo-alumina catalyst. Violent decomposition may occur if it contacts aluminum or its alloys with magnesium under appropriate conditions. A mixture with acetone and a base may possibly result in a highly exothermic reaction. Mixtures with sodium or caustics may form spontaneously flammable substances. Reported to react violently with strong oxidizers or strong caustics and as incompatible with amines, organometallic compounds, and metal hydrides. Reactions of halogenated organic materials such as 1,1,1-trichloroethane with cyanides, mercaptans or other organic sulfides typically generate heat, while those with mineral acids, amines, azo compounds, hydrazines, caustics or nitrides commonly evolve heat and toxic or flammable gases. Reactions with oxidizing mineral acids may generate heat, toxic gases and fires. Those with alkali or alkaline earth metals, certain other chemically active elemental metals like aluminum, zinc or magnesium, organic peroxides or hydroperoxides, or strong reducing agents typically result in heat generation and explosions and/or fires.

IDENTIFICATION

Shipping Names: 1,1,1-Trichloroethane.

Synonyms and Tradenames: Methylchloroform; methyltrichloromethane; polychloropinene; 1,1,1-TCE; alpha-trichloroethane; trichloroethane; trichloro-1,1,1-ethane; trichloromethylmethane; Aerothene or Chlorothene.

Chemical Formula: CH_3CC1_3.

Constituent Components (% each): 100% pure product is available but commercial grades normally contain inhibitors or stabilizers.

UN/NA Designation: UN2831.

IMO Designation: 6.1, poisonous material.

Physical State As Shipped: Liquid.

Physical State As Released: Liquid.

Color of the Shipped Material: Colorless.

Odor Characteristics: Sweetish; mild, like chloroform or ether.

Common Uses: Solvent and extractant; used to clean or degrease many items; used in textile-dyeing, as coolant and lubricant in metal-cutting oils, in aerosol propellants, as fungicide and space fumigant, and for making other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 16 -1200 ppm

Unusual Hazards: The ignition potential and burning characteristics of 1,1,1-trichloroethane are not fully predictable. Inhalation exposures have been associated with cases of "sudden death". See sections on Stability, Corrosiveness, Reactivity with Water, and Reactivity with Other Chemicals for many other unusual characteristics.

Short Term Exposure Limit (STEL): 450 ppm for 15 minutes (ACGIH, 1992 - 93; OSHA, 1989).

Time Weighted Average (TWA) Limit: 350 ppm over each 8 hours of a 40 hour work week (ACGIH, 1992 - 93; OSHA, 1989).

Conditions to Avoid: Heat, fire, strong sparks, hot metal surfaces, and welding arcs; contact with incompatible materials; exposure to ultraviolet radiation (sunlight); runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is clearly from the high concentrations of 1,1,1-trichloroethane vapors that may be present in air in the spill area and over very considerable distances downwind. Direct contact and ingestion should be avoided. There is a possibility, based on experience with similar chemicals, that people who ingest or have ingested alcohol may be at much greater risk of kidney and/or liver damage when exposed to this substance.

Hazards of Skin or Eye Contact: Vapors of 1,1,1-trichloroethane are reported to be slightly irritating to the eyes at concentrations on the order of about 500 ppm in air and above and may cause lacrimation. Contact of the liquid with the eyes is expected to cause slight irritation, pain, and possibly temporary and superficial corneal injury. Brief single exposures of the skin with liquid 1,1,1-trichloroethane may cause a slight prickling or mild burning sensation, mild irritation (if any), and temporary drying of the skin. Prolonged or repeated contact may result in drying, flaking, and cracking of the skin due to defatting action; it may also cause some degree of inflammation. Although the liquid can be absorbed through intact skin, the rate of absorption is so slow that a single skin exposure is not likely to result in absorption of harmful amounts. Do not wear contact lenses when working with this chemical.

Hazards of Inhalation: Vapors are irritating to the nose and throat. Eye irritation and headache are said to result from exposure to 500 ppm for 3 hours. Concentrations above 900 - 1,000 ppm can cause central nervous system depression and symptoms which are variably reported to include dizziness, drunkenness, headache, lightheadedness, drowsiness, fatigue, confusion, loss of equilibrium, vomiting, and incoordination. Concentrations on the order of 5,000 ppm and above may cause respiratory system depression, hypotension, difficult breathing, loss of consciousness and possibly death; they have also been associated with cardiac arrhythmias (irregular heartbeats). More specifically, exposures to 1,000 ppm for 15 - 20 minutes or 2,000 ppm for 5 minutes appear capable of causing lightheadedness, incoordination, and disturbance of equilibrium in the majority of adults. An exposure to 5,000 ppm for 5 minutes is reported as sufficient to cause marked incoordination and anesthesia; prolonged exposure to this level may cause coma and death according to at least one authority. Higher concentrations may cause these effects even sooner. A number of human deaths have been reported in confined spaces, some of which may have been "sudden deaths" due to cardiac sensitization to epinephrine and subsequent cardiac arrest. Autopsies have revealed congestion and edema of the lungs; some cases have involved abdominal pain, liver injury, and congestion of the liver, spleen, kidney and brain. There are also some reports of liver and kidney injury in humans from severe exposures. The NIOSH IDLH (1990) for the substance is 1,000 ppm. The saturated vapor concentration over a pool of liquid 1,1,1-trichloroethane is about 78,950 ppm at 49.1°F (9.5°C); 131,600 ppm at 68°F (20°C); and 263,150 ppm at 97.2°F (36.2°C).

Hazards of Ingestion: The single dose oral toxicity of 1,1,1-trichloroethane is low for most animals tested except dogs. Ingestion is reported to cause many of the symptoms of inhalation as well as irritation and a burning sensation in the mouth, throat and stomach, and severe gastrointestinal irritation characterized by nausea, vomiting and diarrhea, with deaths primarily occurring due to anesthesia in extreme cases. Single oral doses required to kill 50% of rats are in the range of 10.3 to 12.3 grams per kilogram of an animal's body weight. Aspiration into the lungs during vomiting may lead to rapid absorption through the lungs and result in injury to other bodily systems.

FIRE HAZARDS

Lower Flammable Limit: 6 - 10% (See info on flash point earlier).

Upper Flammable Limit: 10.5 -16% (See info on flash point earlier).

Behavior in Fire: Containers may rupture violently in a fire. When within flammable limits in air and upon encountering a suitable source of ignition under appropriate conditions, the vapors of 1,1,1-trichloroethane may ignite and possibly flash back to their source. An explosion or dangerous flash may occur when vapors in a confined space are exposed to a high-energy ignition source. Be advised that ignition will not result in sustained combustion under many circumstances.

Hazardous Combustion Products: Decomposition products at high temperatures or actual combustion products are variably reported to include hydrogen chloride, hydrochloric acid, carbon monoxide, carbon dioxide, dichloroacetylene, chlorine, phosgene, and possibly other highly toxic and/or irritating gases and fumes.

2831

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS *(CONTINUED)*
EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently in a fire. Contact with a variety of other chemicals may result in an explosion or formation of explosive substances. Contact of any hydrochloric acid formed by decomposition of the product or its slow reaction with water may generate flammable and potentially explosive hydrogen gas in contact with certain metals. See "Behavior in Fire" section above for potential vapor explosion hazards.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash- or vapor-proof safety goggles, and other impervious and resistant clothing as needed. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with fumes or smoke generated from burning or thermally decomposing quantities of 1,1,1-trichloroethane. Compatible materials for 1,1,1-trichloroethane itself may include polyvinyl alcohol, Silvershield, Viton/neoprene, and Viton according to one highly respected authority. Another expert source adds that Teflon or a combination of polyethylene and ethylene vinyl alcohol may be appropriate. One authority cautions that polyvinyl alcohol equipment should not be contacted with water. Be advised that many factors affect the suitability of a material for any given application.

Respiratory Protection: A self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

FIRST AID

Nonspecific Symptoms: Irritation of bodily tissues; dizziness, headache, drowsiness, confusion, incoordination, nausea, vomiting, diarrhea, or other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) If vomiting occurs, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Do not administer epinephrine (i.e., adrenalin) or other sympathomimetic drugs to severely exposed individuals unless absolutely necessary since this may possibly result in cardiac sensitization (i.e., myocardial irritability). Do not permit consumption of alcohol after an exposure.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention if irritation persists after washing.

First Aid for Ingestion: Get medical attention immediately. Do not attempt to make the victim vomit. If vomiting occurs naturally, have victim lean forward with head below hips to reduce risk of aspiration of fluids into lungs. Be advised that the danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. See "First Aid for Inhalation" above for discussion of administration of sympathomimetic drugs. Do not permit consumption of alcohol after an exposure.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, water spray. Water may be ineffective.

Extinguishing Techniques: Potential corrosive vapor or fume hazard. Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective clothing if contact with concentrated combustion or thermal decomposition products is anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool until well after fire is out. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If this is impossible, withdraw and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration or bulging of tank due to fire.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind and away from spill area. Avoid contact with spilled product. Eliminate ignition sources. Stop leak if safe to do so. Prevent substance from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

SPILL RESPONSES (CONTINUED)

proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage, rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Ground all equipment and transfer lines as necessary prior to use. Take the unusual flammability, stability, reactivity, and toxicity characteristics of the product into account when planning the response.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors and fumes to dissipate. 1,1,1-Trichloroethane discharges may expose downwind areas to toxic and potentially flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons. Various risks and problems commonly associated with evacuations.

MITIGATION

Stop leak if without risk and if proper equipment available. When evacuation is not judged to be a safe or viable option due to a lack of time or other factors, consider providing downwind populations with the appropriate instructions to seek shelter indoors. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance and advice where necessary.

TECHNIQUE

WATER FOG OR SPRAY.. . Water fog or spray applied to 1,1,1-trichloroethane vapors may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a very small amount (if any) of 1,1,1-trichloroethane and/or other chemicals from contact with its airborne vapors.

MITIGATION

Where deemed necessary, contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of 1,1,1-trichloroethane vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER COVERAGE . . . 1,1,1-Trichloroethane reacts very slowly with water, is heavier than water, and is practically insoluble therein. Gentle application of alight spray of water onto the surface of confined pools of the liquid may form a floating layer of water that reduces vapor emissions.

CONSEQUENCE

Addition of water will increase the volume of contained liquids.

MITIGATION

Contain spilled product and remove as soon as possible. Be alert to conditions that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Liquid 1,1,1-trichloroethane may be contained by building dikes or barriers using soil, sand or other materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCE

Contained liquids may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

LAND RESPONSES (CONTINUED)

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with 1,1,1-trichloroethane or its products of reaction with water may become damaged, develop leaks, and/or cause the initiation of a hazardous reaction. Any hydrochloric acid formed in reactions with water may corrode some metals while generating flammable and potentially explosive hydrogen gas.

MITIGATION

Use dry equipment compatible with the spilled product and other chemicals that may be encountered.

TECHNIQUE

ABSORPTION. . . Spreading of spilled product may be controlled by absorbing liquid with dry sand, earth, clay, fly ash, cement powder, vermiculite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce hazards in the event of afire.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and product residues may be removed by shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Any flammable gases or vapors present in the area may be ignited by motorized removal equipment under appropriate circumstances.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product (and its products or reaction with water where necessary). Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. 1,1,1-Trichloroethane reacts very slowly with water, is heavier than water, and is practically insoluble therein. It may be expected to sink to the bottom of a body of water and dissolve at a very slow rate.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for recovery.

1,1,1-TRICHLOROETHANE
Division 6.1 (Poisonous Material)

WATER SPILL *(CONTINUED)*

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Equipment incompatible with 1,1,1-trichloroethane or its products of reaction with water may become damaged, develop leaks, and/or initiate a hazardous reaction. Any hydrochloric acid formed in reactions with water may corrode some metals while generating flammable and potentially explosive hydrogen gas. Dredged or pumped materials brought to the surface may emit toxic and potentially flammable vapors if exposed to the open air.

MITIGATION

Use equipment compatible with the spilled product and other chemicals that may be encountered. Take appropriate precautions if gases or vapors may pose a fire or explosion hazard. Consult qualified experts for guidance.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards if it is found that significant quantities of acids are present in the water.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

March 1995

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)

GENERAL INFORMATION

Trichloroethylene is a somewhat volatile colorless liquid with an ethereal and sweet odor resembling chloroform. It is used as a solvent, refrigerant, heat exchange fluid, fumigant and disinfectant; for metal degreasing, dry cleaning and electronic part cleaning; and in several other processes and products. It is very slightly soluble in water and heavier, so may be expected to sink and dissolve at a very slow rate. It burns mildly and has a flash point of 90°F, but ignition typically requires high temperatures and a strong flame. Containers of liquid may rupture if exposed to fire or excessive heat for sufficient time duration due to increasing pressure. Vapors are somewhat heavier than air. The weight of the liquid is approximately 12.2 pounds per gallon.

Trichloroethylene is stable in normal transportation and does not react with water. Reactions with granular borium, lithium shavings, high pressure oxygen, sodium or potassium hydroxide, alkali or alkaline earth metals, certain other metals, peroxides, strong reducing agents, and mixtures of dilute hydrochloric acid and aluminum are potentially explosive, however, and the product otherwise reacts with a variety of chemicals. It is additionally considered incompatible with open flames, electrical arcs, aluminum, magnesium, titanium, and zinc. It is a moderately toxic substance, with certain exceptions, but may be present in fairly high concentrations in air. Products of combustion are toxic and irritating. Trichloroethylene has caused cancer in some laboratory animals after repeated or prolonged exposures.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.11 g/100 g water at 77°F (25°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, chloroform, ether, and common organic solvents.

Specific Gravity (Liquid): 1.464-1.466 at 68°F (20°C)

Boiling Point: 180.9°F (82.7°C) or 188.1-188.8°F (86.7-87.1°C) at 1 atm.

Melting Point: – 99.4°F (– 73°C) or – 123.5°F (– 86.4°C); reported values vary.

Freezing Point: See melting point

Molecular Weight: 131.4

Heat of Combustion: Unavailable

Vapor Pressure: 60 mm Hg (1.16 psia) at 68°F (20°C)

Flash Point: 90°F (32.2°C), closed cup reported; but practically nonflammable.

Autoignition Temperature: 770°F (410°C)

Burning Rate: Unavailable

Stability: Stable

Corrosiveness: May attack aluminum or zinc or their alloys when product is uninhibited or lightly inhibited. Listed as incompatible with magnesium and titanium.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with mixture of dilute hydrochloric acid and aluminum, granular barium, nitrogen tetroxide, lithium shavings, magnesium or titanium powder, high pressure oxygen, sodium or potassium hydroxide, caustics, mineral acids, amines, strong oxidizers or reducing agents, nitrides, azo or diazo compounds, hydrazines, cyanides, mercaptans, other organic sulfides, alkali or alkaline earth metals, and peroxides.

IDENTIFICATION

Shipping Names: Trichloroethylene (USDOT and IMO)

Synonyms and Tradenames: Acetylene trichloride; 1-chloro-2,2-dichloroethylene; 1,1-dichloro-2-chloroethylene; ethinyl trichloride; ethylene trichloride; TCE; trichloroethylene; trichloroethene; 1,1,2- or 1,2,2-trichloroethylene; sold under more than 50 tradenames.

Chemical Formula: $CHCl = CC1_2$

Constituent Components(% each): May contain small amounts of stabilizers to prevent decomposition.

UN/NA Designation: UN1710

IMO Designation: 6.1, poisonous substance

Physical State as Shipped: Liquid

Physical State as Released: Liquid

Color of the Shipped Material: Colorless, but may contain dye.

Odor Characteristics: Ethereal, sweet, solventy; like chloroform

Common Uses: Solvent; refrigerant and heat exchange fluid; fumigant and disinfectant; metal degreasing, dry cleaning, electronic part cleaning; mfg. of pharmaceuticals and other chemicals; textile processing; aerospace operations; anesthetic; etc

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (703) 527-3887 (COLLECT)

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 20 ppm or so appears likely

Unusual Hazards: Moderately toxic and volatile liquid.

Short Term Exposure Limits(STEL): 150 ppm for 15 minutes; 200 ppm proposed. (ACGIH)

Time Weighted Average(TLV-TWA): 50 ppm over each 8 hours of a 40 hour work week.(ACGIH)

Conditions to Avoid: Excessive heat, electrical arcs, sparks, and flames; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air. Ingestion and direct physical contact should also be avoided.

Hazards of Skin or Eye Contact: Liquid trichloroethylene is only mildly irritating to the skin if allowed to evaporate. Repeated or prolonged contact may cause roughness, chapping, erythema, and possibly secondary infection. Contact with the eyes may cause burns of the lids, conjunctiva and cornea, but effects are usually temporary.

Hazards of Inhalation: Vapors are irritating to the eyes, nose, and throat. Higher concentrations in air depress the central nervous system and may result in dizziness, weakness, fatigue, nausea, vomiting, headache, blurred vision, unconsciousness, and possibly death. Levels of 1000-1200 ppm in air cause lightheadedness and dizziness in 6 minutes. Alcohol consumption causes the skin of overexposed personnel to become flushed (i.e., reddish).

Hazards of Ingestion: Ingestion may result in gastrointestinal irritation, nausea, vomiting, and diarrhea. Victim may become drowsy or unconscious and exhibit other symptoms of inhalation. Aspiration into the lungs during vomiting may cause delayed chemical pneumonia with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 8%, but 12.5% also reported

Upper Flammable Limit: 10.5%, but 90% also reported

Behavior in Fire: Will burn but very difficult to ignite. Vapors are heavier than air. Containers may rupture violently in fire due to overpressurization. May generate significant quantities of gas or vapor upon release.

Hazardous Combustion Products: Hydrogen chloride, phosgene, carbon monoxide, various hydrocarbons, and possibly other toxic and irritating gases.

EXPLOSION HAZARDS

Lower Explosive Limit: 14.5% at 212°F (100°C)

Upper Explosive Limit:: 18.4% at 212°F (100°C)

Explosiveness: Stable, generally not explosive, but containers may rupture violently in fire due to overpressurization. Contact with certain other chemicals or substances may result in formation of explosive mixtures (see General Information section). There is a remote chance of explosion if vapors of warm liquid are ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

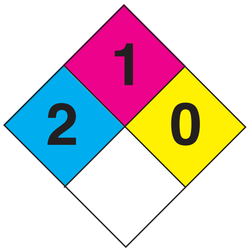
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high fume concentrations in air from decomposed product. Compatible materials may include Viton, chlorobutyl, and nitrile-butadiene rubber.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with an appropriate chin-style or front or back mounted canister within the use limitations of these devices.

1710

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, nose, throat, or skin; other symptoms of inhalation or ingestion.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.) Do not administer epinephrine (adrenalin) as there may be sensitization of the heart.

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact occurs or skin irritation persists after washing.

First Aid for Ingestion: Opinions vary as to whether vomiting should be induced. Contact a physician immediately for instructions and treatment. Keep victim warm and at rest.

FIRE RESPONSE

Extinguishing Materials: Dry chemical, carbon dioxide, foam, or water fog, if needed. Material burns with difficulty.

Extinguishing Techniques: Stay upwind. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with dense fumes/smoke from decomposed material is anticipated. Move container from fire area if no risk. Use water from side and from safe distance to keep fire exposed containers cool.

SPILL RESPONSES

General Information: Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from runoff. Eliminate ignition sources. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of trichloroethylene may result in rupture or explosion of boilers or industrial process equipment. Choose equipment, where possible that is not corroded or otherwise damaged by the spilled product.

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Trichloroethylene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the situation until the spilled product is removed, particularly for smaller spills or in cold weather.

CONSEQUENCE

Hazardous levels of trichloroethylene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Trichloroethylene spills may expose downwind areas to toxic concentrations over considerable distances in some cases, particularly if large amounts have spilled in warm weather.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to trichloroethylene vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of trichloroethylene from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of trichloroethylene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Trichloroethylene may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained trichloroethylene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Streams or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

TRICHLOROETHYLENE

Division 6.1 (Poisonous Material)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon or peat moss to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means. (Note: Dry bentonite clay and powdered dolomitic limestone may also be used for adsorption.)

CONSEQUENCE

Recovery of adsorbents may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

July, 1994

TRIFLUOROCHLOROETHYLENE, INHIBITED
Division 2.3 (Poison Gas)

GENERAL INFORMATION

Trifluorochloroethylene is a colorless and dangerously flammable gas which is shipped as a liquified, compressed gas. It has a faint ether-like odor and low boiling point. When liquids are released they will rapidly boil off, evolving substantial amounts of vapor. Vapors are heavier than air and are likely to concentrate in low lying areas or confined spaces. Vapors may travel a considerable distance to a source of ignition and flashback along the vapor trail. Trifluorochloroethylene is normally stable. However, it will react in the presence of oxygen or air to form unstable peroxides. These peroxides can initiate a rapid, possibly explosive decomposition reaction. Contact with oxygen or air should be avoided.

Trifluorochloroethylene is reported to produce systemic toxic effects specifically acting on the renal (kidney) and liver function. These effects may be delayed in onset. It also behaves as a simple asphyxiant by displacing air and thus, may cause suffocation. Contact with liquids may result in the freezing of exposed tissues.

Containers of trifluorochloroethylene in fire exposed situations may present a threat of violent rupture. Downwind evacuation should be considered to protect persons from exposure to leaking gas. If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for a radius of 1/2 mile. This is to protect personnel from flying debris in the event of a violent rupture. If a cylinder similarly is involved, evacuate for a radius of 1/3 mile to protect from flying debris. When working around trifluorochloroethylene, use only spark-proof tools or explosion-proof (intrinsically safe) equipment. Be alert to conditions which may produce static electrical discharges or other sources of ignition. Under certain conditions, where trifluorochloroethylene is contaminated with unsaturated hydrocarbons (such as ethylene), the reaction may produce shock sensitive products, increasing the risk of explosion.

Trifluorochloroethylene is used in the manufacture chlorofluorocarbon plastics. These plastics are used in a variety of products including gasket materials, electrical insulation, electronic components, and pipes.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Decomposes.
Solubility in Other Chemicals: Soluble in benzene.
Specific Gravity (Liquid): 1.54
Vapor Density (Air= 1): 4.02
Boiling Point: -26 to -28.4°C (-14.8 to -19.2°F)
Melting Point: -157.5°C (251.5°F)
Freezing Point: -157.5°C (251.5°F)
Molecular Weight: 116.47
Heat of Combustion: Unavailable.
Vapor Pressure: 3619 mmHg@ 21.1°C (70°F)
Flash Point: Gas.
Autoignition Temperature: Unavailable.
Burning Rate: Unavailable.
Stability: Normally stable but contact with oxygen or air may result in the formation of peroxides which could initiate an explosive decomposition reaction.
Corrosiveness: Not corrosive.
Reactivity with Water: Decomposes on contact with water. May form toxic carbonyl compounds.
Reactivity with Other Chemicals: May react explosively in the presence of oxidizing agents. Reacts, generating heat, with caustic solutions. Reacts with metals in the presence of water. Will form peroxides in the presence of air or oxygen which may initiate a violent decomposition reaction. Reacts with bromine and unsaturated hydrocarbons (eg. ethylene).

IDENTIFICATION

Shipping Names: Trifluorochloroethylene, inhibited.
Synonyms and Tradenames: 81113; 1-chloro-tirfluoroethylene; CFE; CTFE; 1-chloro-1,2,2-trifluoroethylene; daiflon; ethene, chlorotrifluoro-; ethylene, trifluorochloro; trithene, trifluorovinyl chloride; monochlorotrifluorethylene; CAS 79-38-9.
Chemical Formula: CF_2CFCl
Constituent Components (% each): 99% trifluorochloroethylene inhibited with 1 % tributylamine.
UN/NA Designation: LTN1082
IMO Designation: 2.1, flammable gas.
Physical State as Shipped: Liquefied gas under pressure.
Physical State as Released: Gas and low boiling point liquid.
Color of the Shipped Material: Colorless.
Odor Characteristics: Faint ether-like odor.
Common Uses: Intermediate in manufacture of trifluorochloroethylene resins which are in turn used in the manufacture of piping, gaskets, tank linings, electrical insulation and electronic components

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FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800) 424-9300 OR (202) 483-7616

TRIFLUOROCHLOROETHYLENE, INHIBITED
Division 2.3 (Poison Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: Trifluorochloroethylene is a dangerous fire risk. Vapors may be easily ignited by spark or static discharge. Ignition may proceed at an explosive rate. It is a liquefied, compressed gas and will produce substantial vapors upon release. It will react to form peroxides if exposed to oxygen or air which may initiate violent decomposition. Vapors may travel a considerable distance to an ignition source and flashback to the source. Systemic toxic effects have been reported affecting kidney and liver function. May behave as a simple asphyxiant.

Short Term Exposure Limits (STEL): Not Established.

Time Weighted Average (TLV-TWA): Not Established.

Conditions to Avoid: Contact with heat, fire, sparks, or incompatible materials; contact with peroxides; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Inhalation exposures may result in systemic effects targeting the liver and kidneys. It may also behave as a simple asphyxiant. May produce cardiac arrhythmia as do other chlorofluorocarbon gasses due to cardiac sensitization to adrenalin and norepinephrine. Contact with liquids may freeze tissue due to intense cryogenic action.

Hazards of Skin and Eye Contact: Skin and eye contact with liquid or escaping gasses will result in deep freezing of affected tissue. Defatting of tissues may also result at the point of contact. Symptoms will result in frostbite of exposed areas, numbness, and if not frostbitten, local irritation and redness caused by defatting of the exposed area.

Hazards of Inhalation: Exposure to high concentrations may cause dizziness, nausea, vomiting, loss of coordination, loss of consciousness, and ultimately death by asphyxiation. It is reported to produce systemic effects targeting the kidney and liver function, particularly in situations involving chronic exposures. Systemic effects may be delayed in onset. By analogy with other chlorofluorocarbons, may produce cardiac arrhythmia. May cause asphyxiation by displacing oxygen.

Hazards of Ingestion: Ingestion of trifluorochloroethylene is highly unlikely as it exists as a gas at normal atmospheric pressures and temperatures.

FIRE HAZARDS

Lower Flammable Limit: 8.4 - 16%

Upper Flammable Limit: 34 - 43.7 %

Behavior in Fire: Extremely flammable. May be ignited by static electrical discharges from transfer equipment or sparks from tools. Will produce a substantial volume of flammable vapors on release. Vapors are denser than air and may travel considerable distance to ignition source and flash back. Contact with strong oxidizers may produce fire. Sealed containers, exposed to heating, may rupture violently. May violently decompose after exposure to air or oxygen.

Hazardous Combustion Products: Includes unburned product, oxides or carbon, chlorides and fluorides, halogen acids, and carbonyl compounds.

EXPLOSION HAZARDS

Explosiveness: Forms peroxides on contact with air or oxygen. Peroxide formation may initiate violent decomposition. May ignite explosively. Containers may rupture violently and rocket if exposed to heat or flame impingement.

1082

TRIFLUOROCHLOROETHYLENE, INHIBITED
Division 2.3 (Poison Gas)

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Protective equipment should be chosen to prohibit direct contact with trifluorochloroethylene. Full eye protection with splash proof face shields or protective goggles, rubber boots and gloves, and impervious clothing are appropriate in situations where the threat of direct contact is low. Impervious outer garments should be thermally protective or worn with thermal protection underneath due to exposure to extremely cold liquids or escaping gas.

Respiratory Protection: Positive pressure self contained breathing apparatus or supplied air systems are recommended in fire situations or when dealing with spills. Cartridge respirators are not suitable as trifluorochloroethylene may displace air, creating an oxygen deficient atmosphere.

FIRST AID

Nonspecific Symptoms: May produce severe frostbite at the site of exposure to liquids or cold escaping gasses. May produce systemic effects to kidney and liver functions. May behave as a simple asphyxiant by displacing oxygen. Cardiac sensitizer and, in severe exposures, may produce arrhythmia.

First Aid For Inhalation: Remove victim to fresh air. Remove liquid contaminated clothing and keep victim warm. If liquid is involved, avoid direct contact due to the risk of exposure to extreme cold. Remove contaminated clothing after thawing. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. (Caution: Administration of mouth to mouth resuscitation may expose the first aid provider to chemical within the victims lungs or vomit). Be alert for signs of cardiac arrhythmia. Seek medical assistance immediately. (Note to physician: Monitor for possible effects on renal function. Epinephrine (adrenalin) is contraindicated due to cardiac sensitization.

First Aid For Skin and Eye Contact: May cause severe frostbite. Flush eyes immediately with clean, lukewarm, water for at least 15 minutes, occasionally lifting the eyelid. Seek medical assistance. Wash affected body areas with lukewarm water (do not use hot water or rub affected areas). Remove contaminated clothing after thawing. Seek medical assistance immediately.

First Aid for Ingestion: Ingestion of trifluorochloroethylene is highly unlikely as it is exists as a gas at normal atmospheric pressures and temperatures.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, water fog or spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact with trifluorochloroethylene. Wear self contained breathing apparatus and appropriate personal protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped or safely contained. Be alert that intact containers may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from direct flame impingement. Cool fire exposed containers, with water, from a safe distance and from the side of the container. For massive fires in cargo area, use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting device or discoloration of cargo tank.

TRIFLUOROCHLOROETHYLENE, INHIBITED
Division 2.3 (Poison Gas)

SPILL RESPONSES

General Information: Trifluorochloroethylene is highly flammable and easily ignited. Response strategies should account for the fact that flammable vapors are heavier than air and may travel some distance to a source of ignition. Intact containers containing trifluorochloroethylene may rupture violently if exposed to extreme heat or fire. Eliminate ignition sources. If introduced into sewer system, notify sewer authorities. Ignition of trifluorochloroethylene may result in explosion. As a liquefied gas, spills of trifluorochloroethylene liquid will quickly evaporate, creating large volumes of flammable vapor. Use only spark proof tools when working around trifluorochloroethylene. Be sure lighting systems are of explosion proof design (intrinsically safe). Be alert to sources of ignition and static electrical discharge. Ground all transfer equipment to prevent static charge buildup.

AIR SPILL

TECHNIQUE

EVACUATION... Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Releases may expose downwind areas to flammable concentrations over considerable distances.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Seek expert assistance. Stop leak if without risk and if proper equipment and trained personnel are available. Allow vapors and gas to dissipate completely before reentering spill area without special protective gear.

TECHNIQUE

WATER FOG OR SPRAY... Water fog applied to trifluorochloroethylene vapors or fames may accelerate their dispersal in the atmosphere. Technique is not suitable for use in enclosed environments such as buildings or storage tanks.

CONSEQUENCE

Water runoff may contain toxic carbonyl compounds from reaction with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

Trifluorochloroethylene is a liquefied gas. If conditions are appropriate, liquid spills may auto-refrigerate and form liquid pools. In this state, pools will continue to boil releasing large amounts of vapor. Addition of water to such pools will increase the rate of boiling as water will add energy to the system. Liquid pools of trifluorochloroethylene will present a severe risk of frostbite due to extremely cold temperatures.

TECHNIQUE

CONTAINMENT DIKES... Spills of trifluorochloroethylene liquid on land may be contained by building dikes or barriers using soil, sand, or other materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled materials.

TRIFLUOROCHLOROETHYLENE, INHIBITED
Division 2.3 (Poison Gas)

LAND SPILL *(CONTINUED)*

CONSEQUENCE

Trifluorochloroethylene will continue to warm releasing flammable. and toxic vapors. This will continue to pose significant risks from fire and personnel exposures.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination and reduce gas generation. Seek expert assistance. Be alert to conditions, such as fire hose runoff or rainwater, which may mix with and warm liquid pools. Use water fog to control vapors.

TECHNIQUE

EXCAVATION... A trench or ditch may be excavated to intercept leaking trifluorochloroethylene.

CONSEQUENCE

Trifluorochloroethylene will continue to warm releasing flammable and toxic vapors. This will continue to pose significant risks from fire and personnel exposures. Deep excavations may increase the potential for contamination of groundwater in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove contained product as soon as possible to prevent spread of contamination. Seek expert assistance. Be alert to conditions, such as fire hose runoff or rainwater which may cause trenches to overflow, contaminate, and warm liquefied trifluorochloroethylene. Where possible, line containment areas with suitable, impervious material.

TECHNIQUE

PUMPINGNACUUM SUCTION... Accumulated trifluorochloroethylene pools may be recovered using appropriate hoses, pumps, and storage containers. Seek expert assistance.

CONSEQUENCE

Equipment which is incompatible with spilled product may become damaged. Contaminated trifluorochloroethylene may react violently or explosively during transfer. Static discharges can cause ignition. Mechanical equipment will become contaminated with removed product. Contaminated soil will likely remain after product removal is completed.

MITIGATION

GROUND ALL TRANSFER EQUIPMENT. Use only explosion proof (intrinsically safe) equipment constructed of compatible materials. Seek expert assistance. Plan for the removal of remaining contaminated soil after product is removed.

WATER SPILL

Trifluorochloroethylene is a gas and will not form spills in water unless gas is release from submerged tank. If released in a liquid form, it will react and boil-off rapidly evolving substantial vapors. Trifluorochloroethylene will react with water to decompose, forming toxic carbonyl compounds.

September 2003

1,1,1-TRIFLUOROETHANE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

1,1,1-Trifluoroethane is a common refrigerant gas, also known as Freon 143a and Refrigerant Gas 143a. It is a flammable, colorless, liquefied compressed gas having a slight ethereal sweetish odor. It is used as refrigerant, blowing agent and aerosol propellant. It is stable, although any source of ignition should be avoided. It is relatively insoluble in water and, as such, liquid spills on water will boil off rapidly with very small amounts dissolving. Contact with strong bases or alkaline materials may provoke violent reactions or explosions. All spills on land or water will evolve relatively large amounts of flammable gases or vapors that are heavier than air, may travel a considerable distance to a source of ignition and flash back and may persist in pits, hollows and depressions. Accumulations of gas in confined spaces such as buildings or sewers may result in explosions if ignited. The primary route of entry is inhalation of the vapors. 1,1,1-Trifluoroethane has no toxicity reported except that it may asphyxiate and cause frost-like burns of the skin or eyes from contact with liquid. Inhalation in moderate amounts may cause headaches, drowsiness and dizziness. Larger amounts may cause unconsciousness and death due to asphyxiation.

The explosive potential for 1,1,1-trifluoroethane is high. It will readily ignite from any source of ignition, including static electricity and friction from escaping gas. Explosive mixtures are formed with air. Products of combustion may include irritating and toxic fumes of carbon monoxide, carbonyl fluoride and hydrogen fluoride. Initial downwind evacuation should be considered for at least one-half (1/2) mile if product is leaking but not on fire. If container of 1,1,1-trifluoroethane is exposed to direct flame or a fire becomes uncontrollable, evacuate for one (1) mile in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble (0.05% at 77°F (25°C))
Solubility in Other Chemicals: Unavailable
Specific Gravity: 0.94
Vapor Density (Air=1): 2.9
Boiling Point: -53°F (-47°C)
Melting Point: -168°F (-111°C)
Freezing Point: See melting point
Molecular Weight: 84.04
Heat of Combustion: Unavailable
Vapor Pressure: 10,1000 mm Hg at 86°F (30°C)
Flash Point: -130°F (-90°C)
Autoignition Temperature: 1382°F (750°C)
Burning Rate: Unavailable
Flammable Limits: 7.1% (LEL) - 17% (UEL)
Stability: Stable. Avoid sparks or flame source that can cause ignition.
Polymerization Potential: Will not occur
Reactivity and Incompatibility: Contact with strong bases or alkaline materials may provoke violent reactions or explosions.

IDENTIFICATION

Shipping Name(s): 1,1,1-Trifluoroethane, compressed <or> Refrigerant gas 143a (USDOT); 1,1,1-Trifluoroethane (IMO)
Synonyms and Tradenames: Freon 143a; HFC-143a; Methylfluoroform; Refrigerant Gas 143a
CAS Registry No: 420-46-2
Chemical Formula: $C_2H_3F_3$
Constituent Components (% each): 99 - 100%
UN/NA Designation: UN2035
IMO Designation: 2.1, Flammable gases
RTECS Number: Unavailable
NFPA 704 Hazard Rating (Gas): 1 (Health): 4 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Compressed gas or liquid
Physical Form as Released: Gas or boiling liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Sweetish, ethereal odor
Common Uses: It is used as refrigerant, blowing agent and aerosol propellant.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

1,1,1-TRIFLUOROETHANE

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Highly flammable. Liquid form of 1,1,1-trifluoroethane can cause frost-like burns. Inhalation of large concentration of gas may cause dizziness, drowsiness and unconsciousness.

Short Term Exposure Limit (STEL): Unavailable

Time Weighted Average (TLV-TWA): Unavailable

Ceiling (C) Limit: Unavailable

IDLH: Unavailable

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity and incompatible materials.

HEALTH HAZARDS

Potential Health Hazards: 1,1,1-Trifluoroethane has no toxicity reported except that it may asphyxiate and cause frost-like burns with skin or eye contact.

Hazards of Skin or Eye Contact: Eye or skin contact with liquid can cause frostbite type injury due to rapid cooling from evaporation.

Hazards of Inhalation: Narcotic or anesthetic effects depend on the duration of exposure and vary from incoordination, headache, dizziness, periods of excitation, inability to see well, to anesthesia and eventual unconsciousness.

Hazards of Ingestion: Ingestion is unlikely due to physical properties of 1,1,1-trifluoroethane. Contact with the extremely cold liquid would, at the very least, cause frostbite of the mouth and throat.

FIRE HAZARDS

Lower Flammable Limit: 7.1%

Upper Flammable Limit: 17%

Behavior in Fire: Flammable gas. It will readily ignite if exposed to sources of heat and flame. Vapors may be heavier than air, may travel along the ground and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity and other potential ignition sources at locations distant from the point of release. Containers exposed to prolonged fire or heat may violently rupture.

Hazardous Decomposition Products: Products of combustion may include irritating and toxic fumes of carbon monoxide, carbonyl fluoride and hydrogen fluoride.

EXPLOSION HAZARDS

Explosive Potential: High. Severe explosion hazard when exposed to heat, flame, strong bases or alkaline materials. Explosive when mixed with air. Escaping gas may ignite spontaneously due to friction. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Containers exposed to prolonged fire or heat may violently rupture.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

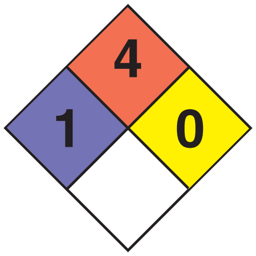
Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

Respiratory Protection: For unknown concentrations, fire fighting or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

2035

1,1,1-TRIFLUOROETHANE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Contact of liquid with skin or eyes may cause frost-like burns. Inhalation is the major route of exposure and can cause headache, drowsiness, dizziness and unconsciousness.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. If victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be administered. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

First Aid for Skin Contact: In case of skin contact with cold liquid, remove contaminated clothing and wash affected body areas with large amounts of warm water. Do not use hot water or rub frozen areas. Let circulation establish itself naturally. Encourage victim to exercise the affected part while it is being warmed. Use other means of warming such as wrapping effected area gently in blankets if warm water is not available. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, flush eyes with large amounts of water while lifting upper and lower eyelids frequently. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Ingestion is unlikely. If liquid is ingested, frostbite-like injury can occur. Drink warm water to relieve frostbite, but do not induce vomiting without medical supervision. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility.

FIRE RESPONSE

Extinguishing Agents: Stop the flow of gas. Use carbon dioxide, dry chemical or water spray (fog). A fine water spray or fog can be used on large discharges to control the fire by preventing its spread and absorbing some of its heat.

Extinguishing Techniques: Stay upwind. Secure ignition sources in the immediate spill area and downwind. Approach fire from upwind to avoid flammable vapors. Wear positive-pressure, self-contained breathing apparatus and appropriate protective clothing. Wear full chemical and/or thermal protective suit as necessary and appropriate. Move container from fire area if no risk. Do not extinguish fire unless flow can be stopped safely. If flames are extinguished, vapors may travel to distant sources of ignition and flash back or explosive re-ignition may occur. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to prolonged heat, such as from a direct flame. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors and to protect personnel. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from area and allow fire to burn out. Immediately withdraw in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to prolonged fire or heat may rupture violently, particularly the ends, and travel considerable distances. Dike fire control water for proper disposal since it may contain flammable gases.

1,1,1-TRIFLUOROETHANE
Division 2.1 (Flammable Gas)

SPILL RESPONSES

General Information: 1,1,1-Trifluoroethane is highly flammable. Eliminate all sources of ignition. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with very cold gas or liquid unless properly equipped for such contact. If transfer operations are anticipated, only use equipment specifically designed for use with the material being transferred and its temperature and pressure at the time of transfer. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof and non-sparking equipment to minimize the potential for ignition. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished safely. Water spray may be used to reduce the generation of vapors. Prevent substance from entering sewers, waterways and confined spaces. Runoff may be flammable. Note that accumulations of cold gas resulting from liquid spills may persist in pits, hollows and depressions. Use combustible gas detectors prior to entering any potentially affected confined space or any low area in which cold, heavier-than-air gases or vapors may have accumulated. Do not direct water at a venting safety device since this may cause icing to occur. Note that the rapid escape of gas under pressure may generate a static electricity charge that could cause gas ignition. Be advised that the very low temperatures associated with 1,1,1-trifluoroethane can cause many materials to become brittle and subject to sudden failure or cracking. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

AIR SPILL

TECHNIQUE

EVACUATION . . . As a general precaution, isolate the area for $^1/_2$ mile in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts and the available safe locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Consult qualified experts for assistance in isolating an area and handling an evacuation.

TECHNIQUE

WATER FOG OR SPRAY . . . Water sprays may be used to reduce vapors.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

MITIGATION

Contain contaminated water and remove or treat as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

1,1,1-TRIFLUOROETHANE

Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . If released to the soil, initially liquid will rapidly boil, generate a large amount of flammable vapors and freeze the ground it is in contact with. Much later, the liquid will reach a less rapid boiling rate thereby evolving less vapors. Containment dikes or barriers using soil, dry sand or other related, non-combustible materials may be effective to confine the spill to a limited area thereby reducing the surface area and volume of gas generated until liquid evaporates. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material.

CONSEQUENCE

Contained material will take longer to evaporate.

MITIGATION

Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater, which may overfill diked areas.

TECHNIQUE

EXCAVATION . . . Spills of material may be contained by building trenches or ditches. Reducing the spill surface area may decrease vapor generation.

CONSEQUENCE

Contained material will take longer to evaporate. Mechanical equipment could ignite material.

MITIGATION

Continually monitor for flammable conditions. Dig a deep pit with small area to reduce vapor generation rate. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill pits.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. Due to its relatively low boiling point, high pressures may develop very rapidly in recovery equipment at moderate to high ambient temperatures.

MITIGATION

Use compatible equipment of proper pressure capacity. Consider using a cold gas such as carbon dioxide or nitrogen to precool transfer lines and receiving containers to avoid high initial vaporization rates when equipment temperatures exceed the boiling point of the liquid to be recovered. Consult qualified experts as necessary for assistance.

TECHNIQUE

MECHANICAL REMOVAL . . . Most if not all the product will rapidly vaporize from soil surfaces once the bulk of the liquid has vaporized. Mechanical equipment can be used to grade frozen ground to eliminate any pockets of material.

CONSEQUENCE

Any flammable vapors present in the area may be ignited by motorized removal equipment.

MITIGATION

Continually monitor for flammable conditions.

1,1,1-TRIFLUOROETHANE

Division 2.1 (Flammable Gas)

WATER SPILL

Note: Liquid 1,1,1-trifluoroethane will boil or rapidly vaporize from the surface of a water body with very little dissolution, if any, in the majority of cases.

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake and monitor situation.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONFINEMENT DAMS . . . Water with spilled chemical may be confined (or diverted to impoundment area) by damming upper and/or lower bounds to limit volume of water affected and spread of contamination. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. Additional water may cause overflow of dammed area or water body boundaries.

MITIGATION

Reinforce or modify dams as necessary. Be alert for conditions that may lead to overflow, saturation or dam collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill confinement booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6-8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current are present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

January 1988

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

GENERAL INFORMATION

Trimethylamine is a colorless gas that may be shipped as a liquid under pressure (anhydrous) or as a volatile 25 - 40% solution in water (aqueous). It has a pungent, fishy, possibly ammoniacal odor and is used as a warning agent for natural gas and in disinfectants, flotation agents, insect attractants, plastics, and the making of other chemicals. It is moderately soluble in water and will quickly dissolve to form an alkaline solution. Flash points for the anhydrous material and the 25% solution are respectively 20°F and 38 - 42°F, thus indicating ease of ignition under a wide range of ambient temperature conditions. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers may rupture violently if exposed to fire or excessive heat for sufficient time duration. The anhydrous product weighs approximately 5.3 pounds per gallon.

Trimethylamine is stable in normal transportation and does not react with water or many common materials. Reactions with mercury may be explosive, however, and the product is otherwise reactive with a wide variety of chemicals. It is also corrosive to aluminum, copper and its alloys, galvanized metal, zinc alloys, and magnesium. Toxicity is relatively high by all routes of exposure. Products of combustion are also toxic, particularly if burning takes place under oxygen starved conditions.

Downwind evacuation should be considered if trimethylamine is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (1/2) mile for the anhydrous material and for a radius of one-third (1/3) mile for aqueous solutions for protection from flying debris if the container should rupture violently.

If the aqueous solution is leaking (not on fire) and generating vapors or fumes, downwind evacuation of the immediate spill area should be considered until properly equipped responders have evaluated the hazard.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble, 41 g/100 g water at 66.2°F (19°C)

Solubility in Other Chemicals: Soluble in alcohol, benzene, chloroform, and ether.

Specific Gravity (Liquid): 0.632-0.636 at 68°F (20°C) for anhydrous

Boiling Point: 37.2°F (2.9°C) for anhydrous; 109°F (43°C) for 25% solution; both at 1 atm.

Melting Point: - 178.8 to - 179.1°F (- 117.1 to - 117.3°C) for anhydrous

Freezing Point: 43°F (6°C) for 25%; 39°F (4°C) for 40% solution

Molecular Weight: 59.11

Heat of Combustion: - 9810 cal/g

Vapor Pressure: 1.9 atm (27.9 psia) for anhydrous, 470 mm Hg (9.09 psia) for 40%, 346 mm Hg (6.69 psia) for 25% solution; all at 68°F (20°C)

Flash Point: 20°F (- 6.7°C), closed cup, for anhydrous; 42°F (6°C), closed cup, for 25% solution.

Autoignition Temperature: 374°F (190°C) for anhydrous

Burning Rate: 8 mm/minute for anhydrous

Stability: Stable

Corrosiveness: Corrosive to aluminum, copper and its alloys, galvanized metal, zinc alloys, and magnesium.

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with oxidizing agents, acids, aldehydes, halogenated organics, certain peroxides, isocyanates, epoxides, alkali and alkaline earth elemental metals, strong reducing agents, dithiocarbamates, mercury when ammonia is present, and nitrosating agents like nitrous acid, sodium nitrite, or nitrogen oxides.

IDENTIFICATION

Shipping Names: Trimethylamine, anhydrous (USDOT); trimethylamine, aqueous solution (USDOT); trimethylamine (IMO)

Synonyms and Tradenames: n,n-Dimethyl, methyl amine; methanamine, n,n-dimethyl; TMA.

Chemical Formula: $(CH_3)_3N$

Constituent Components(% each): 98.5% or more pure when anhydrous, or 25 - 40% solution in water, with traces of ammonia and other methyl amines.

49 STCC: 49 055 40 (anhydrous); 49 078 80 (solution).

UN/NA Designation: UN1083 (anhydrous); UN1297 (aqueous solution).

IMO Designation: 2.1 (anhydrous), flammable gas; 3.2 (solution), flammable liquid

Physical State as Shipped: Liquefied compressed gas (anhydrous) or liquid solution.

Physical State as Released: Gas, boiling liquid, or liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Fishy below 100 ppm; ammoniacal above 100 ppm

Common Uses: Warning agent for natural gas; flotation agent; insect attractant; mfg. of disinfectants, plastics, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

See UN/NA Designation for other ID numbers.

The number 3 will appear at the bottom for the aquous solution.

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.21 ppb

Unusual Hazards: Highly volatile, flammable and toxic substance with heavier than air vapors that may persist in pits, hollows, and depressions.

Short Term Exposure Limits (STEL): 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major health hazard is from inhalation of vapors which may be present at high concentrations in air. Ingestion and direct physical contact are also to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of liquid trimethylamine with the skin may cause severe skin burns while concentrated vapors may produce skin irritation and dermatitis. Contact of the liquid or concentrated vapors with the eyes may result in severe eye damage. The anhydrous liquid may also cause frostbite.

Hazards of Inhalation: *Low* levels in air are irritating to the eyes and respiratory tract. Higher levels (above 100 ppm) may also cause lung irritation with respiratory distress and cough. Severe exposures may result in chemical pneumonitis, pulmonary edema, and delayed scarring of the airway or other organs.

Hazards of Ingestion: Data unavailable, but minimally expect irritations or burns of the mouth, throat, and stomach. It may be possible that aspiration into the lungs during vomiting may cause pulmonary edema or chemical pneumonia with possibly severe consequences.

FIRE HAZARDS

Lower Flammable Limit: 2%

Upper Flammable Limit: 11.6%

Behavior in Fire: Flammable compressed gas or liquid. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Will generate large quantities of flammable and toxic gas or vapor upon release.

Hazardous Combustion Products: Carbon monoxide and nitrogen oxides with sufficient oxygen. Incomplete combustion may also produce hydrogen cyanide, nitriles, cyanic acid, nitrosamines, and other highly toxic substances.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Contact with mercury may in formation of explosive mixtures.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be advisable in some cases to prevent contact with high vapor or fume concentrations in air. Compatible materials may include chlorinated polyethylene.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent).

1083

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

FIRST AID

Nonspecific symptoms: Irritations or bums of any bodily tissues.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately. Control shock if present.

First Aid for Ingestion: If victim is conscious, administer 3 - 4 glasses *of* milk or water immediately. Do not attempt to make the victim vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Alcohol foam, carbon dioxide, dry chemical, water fog or spray. Water may be used in large amounts to dilute solutions below flammable limits.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to a pool of liquid anhydrous trimethylamine may increase vapor evolution for a time.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in rupture or explosion of boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the specific response that trimethylamine is highly volatile, flammable, toxic, and corrosive. Do not use equipment containing mercury. Beware of possible heavy vapor accumulations in pits or depressions.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Trimethylamine spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to trimethylamine vapors or fumes may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. If pools of anhydrous liquid are present, water spray should be applied at a point downwind of the spill and should probably not be allowed to contact the anhydrous liquid, as this may increase vapor evolution.

CONSEQUENCE

Water runoff may contain varying amounts of trimethylamine from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

DILUTION . . . The addition of a relatively large amount of water to liquid trimethylamine may slow the release of vapors into the atmosphere.

CONSEQUENCE

Addition of water will increase the volume of material requiring recovery. Vapor evolution may temporarily increase if liquid pools of anhydrous product are present.

MITIGATION

Contain spilled product and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Proceed with caution.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of trimethylamine vapors into the atmosphere. (Note: The fact that alcohol foam is recommended for fire fighting suggests it may also have value in suppressing vapor evolution.)

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. Application of foam to pools of anhydrous liquid may increase vapor evolution for a short time.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternative technique if the response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES. . . Trimethylamine may be contained by building dikes using soil, sand or other materials.

CONSEQUENCE

Contained trimethylamine may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks. High pressures may be developed in equipment if product is anhydrous liquid.

MITIGATION

Use equipment compatible with spilled product and of proper pressure capacity.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, saw dust, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TRIMETHYLAMINE
Division 2.1 (Flammable Gas) or Class 3 Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

August 1996

TRIPROPYLENE
Class 3 (Flammable Liquid)

GENERAL INFORMATION

Tripropylene is a colorless flammable liquid of the olefin family with a sharp penetrating odor used principally as a lubricant additive. Tripropylene is also used as a chemical intermediate in the manufacture of isodecyl alcohol, nonylphenol and tert-nonyl mercaptan. Tripropylene is manufactured from the polymerization of a C_3 petroleum stream containing 40-60% propylene in the presence of a phosphoric acid catalyst. Tripropylene may be irritating to the eyes, skin and respiratory tract. It is considered a central nervous system (CNS) depressant in high concentrations, and can produce anesthetic effects such as dizziness and suffocation. In poorly ventilated areas or confined spaces, unconsciousness and asphyxiation may result. It may be toxic if inhaled or absorbed through the skin for prolonged periods. The most common routes of exposure are through inhalation, skin and eye contact.

Vapors are heavier than air and may settle in low lying areas. Vapors may travel considerable distances to ignition sources and flash back. Normal structural firefighting protective clothing will only provide a limited level of personal protection for working in contaminated atmospheres. Runoff may be flammable and/or toxic. Tripropylene is not water soluble and will float on the surface of water. Empty containers containing product residue may present a flammability hazard and proper safety precautions should be followed.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble.
Solubility in Other Chemicals: Miscible with alcohol, ether and other organic solvents.
Specific Gravity (Liquid): 0.7 @ 20°C (68°F)
Vapor Density (Air=1): 4.3
Boiling Point: 132°C (270°F)
Melting Point: Unavailable.
Freezing Point: Unavailable.
Molecular Weight: 126.27
Heat of Combustion: -10,600 CAL/G.
Evaporation Rate: Unavailable.
Vapor Pressure: 8 mm Hg at 20°C (68°F)
Flash Point: 24°C (75°F)
Autoignition Temperature: Undetermined.
Flammable Limits: 0.7% (LEL) - 3.9% (UEL): Estimated.
Stability: Stable.
Polymerization Potential: Will not occur.
Reactivity and Incompatibility: Can react with strong oxidizing agents and acids.
Other Characteristics: Products evolved when subjected to heat or combustion include toxic levels of carbon monoxide, and irritating aldehydes and ketones.

IDENTIFICATION

Shipping Name(s): Tripropylene (USDOT & IMO)
Synonyms and Tradenames: Propylene Trimer, Nonene. CAS Registry No.: 27215-95-8.
Chemical Formula: C_9H_{18}
Molecular Formula: C_9H_{18}
UN/NA Designation: UN2057
IMO Designation: 3.2
RTECS Number: NIOSH/RA8550000
OHMTADS Number: Unavailable.
NFPA 704 Hazard Rating: 1 (Health): 3 (Flammability): 0 (Reactivity)
Physical Form as Shipped: Liquid
Physical Form as Released: Liquid
Color of the Shipped Material: Clear/colorless
Odor Characteristics: Sharp, penetrating odor
Common Uses: Tripropylene is used as a lubricant additive, and as a chemical intermediate in the manufacture of isodecyl alcohol, nonylphenol and tert-nonyl mercaptan.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

TRIPROPYLENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable.

Unusual Hazards: It is a central nervous system depressant and may act as an asphyxiant in some situations.

Time Weighted Average (TLV-TWA): 200 ppm.

Short Term Exposure Limit (STEL): Not established.

IDLH: Not established.

Conditions to Avoid: Heat, sparks, flame, impact, friction, static electricity, and incompatible materials such as oxidizing agents and acids.

HEALTH HAZARDS

Potential Health Effects: Tripropylene is an irritant to the skin, eyes and respiratory tract. It may be poisonous if inhaled or absorbed through the skin in high concentrations. Inhalation may cause mucous membrane irritation, cyanosis, headache, dizziness, confusion, and unconsciousness. It is a central nervous system (CNS) depressant. Individuals with pre-existing conditions of the central nervous system or lungs may have increased susceptibility to the toxicity of excessive exposures.

Hazards of Skin Contact: Skin contact may cause skin irritation with rash, redness, and burning. Prolonged exposures may lead to skin burns, blistering and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, swelling, tearing, conjunctivitis, corneal damage or blurred vision.

Inhalation Hazards: Inhalation may cause irritation to the upper respiratory passages and mucous membranes, dyspnea, pneumonitis, and pulmonary edema in high concentrations. Prolonged exposures can produce chemical pneumonitis and central nervous system (CNS) effects such as cyanosis, nausea, headache, dizziness, confusion, and loss of consciousness.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, vomiting, diarrhea, and abdominal pain. Aspiration may occur during swallowing or vomiting resulting in lung damage.

FIRE HAZARDS

Lower Flammable Limit: 0.7%

Upper Flammable Limit: 3.9%

Behavior in Fire: Tripropylene is a flammable liquid with significant fire potential. It will readily ignite and burn if exposed to sources or ignition, heat and flame. Vapors are heavier than air, will travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may be ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic.

Hazardous Decomposition Products: When heated to decomposition, material releases toxic levels of carbon monoxide and irritating aldehydes and ketones.

EXPLOSION HAZARDS

Explosive Potential: Moderate. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas where vapors can accumulate, since it may present a vapor explosion hazard.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

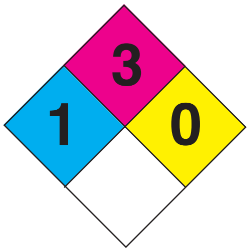
Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Chemical liquid splash protective clothing (EPA Level B Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are nitrile rubber, viton® and neoprene. Structural firefighting protective clothing will provide only a limited level of personal protection for this product. Where the potential threat of direct contact with the material is low, splash-proof face shields or protective goggles, rubber boots, and gloves may be worn.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations. NIOSH/MSHA approved air purifying respirators with an organic vapor cartridge or canister may be permissible under certain circumstances such as post-emergency clean-up operations and where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited.

2057

TRIPROPYLENE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Skin contact with the liquid may cause redness, swelling, burning, and dermatitis. Excessive exposures may cause temporary central nervous system (CNS) effects such as dizziness, drowsiness, nausea, headache, confusion, and loss of consciousness. Eye contact may cause redness, swelling, tearing, and blurred vision. Inhalation may cause irritation to the upper respiratory passages and mucous membranes with coughing and discomfort.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water for at least 15 minutes. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: Immediately give two (2) glasses of water if victim is conscious and can swallow, BUT DO NOT INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

Note to Physicians: Aspiration of this material during induced emesis may result in severe lung injury. If evacuation of the stomach is necessary, use method least likely to cause aspiration, such as gastric lavage after endotracheal intubation.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog), or foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, protect personnel, and dilute spills to form non-flammable mixtures. Solid streams of water may be ineffective. Use water in flooding quantities as fog. Fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may explode violently, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may be flammable and/or toxic.

SPILL RESPONSES

General Information: Tripropylene is a flammable liquid that may cause environmental contamination. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Secure all potential sources of ignition in the immediate area and downwind. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Non-sparking tools and explosion-proof equipment are recommended to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, storm drains and waterways. Do not flush spills because the material floats on water and may be carried off-site and spread fire. Overflow dams may be used to dike material since it does not mix with water and it is lighter than water. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered loosely. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential sources of ignition such as heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, storm drains, and waterways.

TECHNIQUE

MONITOR THE SITUATION...Based on its vapor pressure, tripropylene is expected to exist almost entirely in the gaseous phase if released into the atmosphere. Since its vapors are heavier than air, the highest concentrations of vapor will be located at ground level in low lying and enclosed areas. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Secure all potential ignition sources in the area. Evacuate the immediate area and downwind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used effectively to control the production of vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, storm drains, and waterways.

TECHNIQUE

FOAM...Aqueous Film Forming Foam (AFFF) or compatible hazardous materials foam agents applied to the surface of liquid pools may reduce the rate of vapor generation.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

TRIPROPYLENE
Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released to water, tripropylene is not expected to strongly adsorb. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion on the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is only slightly water soluble. Dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

Overflow dams may be used to confine the spill to a limited area until appropriate clean-up activities can be initiated. The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may be somewhat effective to recover spilled material since the material is not water soluble and will float on the surface. Barriers of suitable material may also be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Material may travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming may be effective since the material is not water soluble and will float on the surface of the water.

CONSEQUENCE

Material may travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TRIPROPYLENE
Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...If released into soil, tripropylene is not expected to strongly adsorb to soil, but will be expected to exhibit high mobility. It may be susceptible to volatilization from near surface soils based upon the predicted rapid volatilization rates from surface water and its relatively high vapor pressure. Spilled material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed.

CONSEQUENCE

Material is highly mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

January 1988

URANIUM HEXAFLUORIDE
Class 7 (Radioactive Material)

GENERAL INFORMATION

Uranium hexafluoride is a fairly volatile, colorless, white, or pale yellow radioactive solid that is shipped as a fissile material (containing more than 1.0 percent U-235) or as a material with low specific activity (containing 1.0 percent or less U-235). Radioactive materials emit certain rays that may be hazardous, but these shipments are generally of low radioactivity. Fissile materials, however, if improperly handled, may become critical. This means that if too large quantities of these materials are permitted in one place, a very rapid nuclear reaction may occur. This would not be explosive, but large amounts of radiation would be emitted suddenly and might injure nearby personnel. In case of trouble with such shipments, all unauthorized persons should be kept as far away as possible until qualified people with proper equipment can be obtained from the local or state radiological response team, the U.S. Department of Energy, or the shipper.

Note, however, that the primary hazard associated with uranium hexafluoride is its corrosivity.

Uranium hexafluoride reacts vigorously with water, alcohol, ether, and most metals and is a severely corrosive and toxic substance by all routes of exposure to people and animals when concentrated. The reaction with water or moisture in air forms $U0_2F_2$, hydrogen fluoride, and hydrofluoric acid. The latter substance is highly toxic and corrosive to glass, concrete, metals containing silica, natural rubber, leather, and many organic materials. Although uranium hexafluoride itself is not flammable, any hydrofluoric acid formed may generate flammable and potentially explosive hydrogen gas in contact with some metals.

Downwind evacuation should be considered if spilled uranium hexafluoride contacts water or moist air.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Reacts vigorously; see below.
Solubility in Other Chemicals: Soluble in liquid bromine, chlorine, carbon tetrachloride, symtetrachloroethane, and fluorocarbons.
Specific Gravity (Solid): 4.7 - 5.1 at 68 - 77°F (20 - 25°C)
Boiling Point: Sublimes; vapor pressure is 760 mm Hg at 132.3°F (55.7°C)
Melting Point: 148.1-148.6°F (64.5-64.8°C)
Freezing Point: See melting point
Molecular Weight: 352.07
Heat of Combustion: Not flammable
Vapor Pressure: 109 mm Hg (2.11 psia) at 68°F (20°C)
Flash Point: Not flammable
Autoignition Temperature: Not flammable
Burning Rate: Not flammable
Stability: See general information section.
Corrosiveness: Shipped in special steel cylinders. Any hydrofluoric acid formed is highly corrosive.
Reactivity with Water: Reacts vigorously to form uranyl fluoride ($U0_2F_2$) and hydrogen fluoride (hydrofluoric acid).
Reactivity with Other Chemicals: Reacts vigorously with alcohol, ether, and most metals. See guide for hydrofluoric acid for additional data.

IDENTIFICATION

Shipping Names: Uranium hexafluoride, fissile (USDOT); uranium hexafluoride, low specific activity (USDOT).
Synonyms and Tradenames: Uranium fluoride; uranium (VI) fluoride
Chemical Formula: UF_6
Constituent Components(% each): Fissile material has more than 1.0% U-235; low specific activity material has 1.0% or less U-235.
49 STCC: 49 274 90 (fissile); 49 264 90 (l.s.a.)
UN/NA Designation: UN2977 (fissile); UN2978 (l.s.a.)
IMO Designation: 7, radioactive substance
Physical State as Shipped: Crystalline solid
Physical State as Released: Crystalline solid
Color of the Shipped Material: Colorless, white, or pale yellow
Odor Characteristics: Unavailable
Common Uses: Used in gaseous diffusion process for separating isotopes of uranium.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

URANIUM HEXAFLUORIDE
Class 7 (Radioactive Material)

USDOT: Identification numbers
cannot be displayed on the placard
(49 CFR § 172.334).

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Unavailable

Unusual Hazards: Fairly volatile, radioactive, corrosive and toxic substance. Hydrofluoric (HF) acid fumes evolved in reactions with water or moisture in air are exceptionally hazardous.

Short Term Exposure Limits (STEL): 0.6 mg/m^3 as U (6 ppm for HF as F) for 15 minutes (ACGIH)

Time Weighted Average (TLV-TWA): 0.2 mg/m^3 as U (3 ppm for HF as F) over each 8 hours of a 40 hour work week. (ACGIH)

Conditions to Avoid: Heat, fire, and sparks; contact with incompatible materials; entry to sewers or water bodies; inhalation, ingestion, ox direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Uranium hexafluoride is highly corrosive. Inhalation of dust, vapors; or fumes in air, ingestion, and direct physical contact with any form of the substance are to be strictly avoided.

Hazards of Skin or Eye Contact: Contact of the skin with uranium hexafluoride may result in severe and painful hydrogen fluoride burns. Contact of the eyes with the solid or its vapors and fumes may cause severe injury and possibly blindness.

Hazards of Inhalation: Exposure to dust of the solid or its vapors and fumes in air may cause severe burns to the respiratory tract, may injure the kidneys, and may be fatal.

Hazards of Ingestion: Ingestion may result in internal hydrogen fluoride burns.

FIRE HAZARDS

Lower Flammable Limit: Not flammable

Upper Flammable Limit: Not flammable

Behavior in Fire: Containers may possibly explode or rupture in fire. May generate large quantities of corrosive vapors or fumes upon release. Finely divided solid may be pyrophoric.

Hazardous Combustion Products: Toxic and corrosive fumes may be generated in fires.

EXPLOSION HAZARDS

Lower Explosive Limit: Not flammable

Upper Explosive Limit: Not flammable

Explosiveness: Containers may possibly explode or rupture in fire. Any hydrogen gas evolved may explode if ignited in a confined area.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any possibility of skin or eye contact with the corrosive spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. Fully encapsulating suits with self-contained breathing apparatus (SCBA) may be necessary to prevent contact with high vapor or fume concentrations in air. All clothing should be acid resistant since the main hazard is corrosivity.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 2.5 mg/m^3 ppm), a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with chin-style or front or back mounted acid gas canister and a high efficiency particulate filter or an acid gas cartridge respirator with a full facepiece, acid gas cartridge(s), and a high efficiency particulate filter within the use limitations of these devices.

2977

URANIUM HEXAFLUORIDE
Class 7 (Radioactive Material)

See "UN/NA Designation" for other ID numbers.

FIRST AID

Nonspecific symptoms: Irritations or burns due to any route of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention immediately.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: As needed for surrounding fire. Note that water may increase evolution of hydrofluoric acid fumes.

Extinguishing Techniques: Corrosive vapor or fume hazard. Reacts with water. Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Wear full chemical protective suit if contact with material or dense fumes/smoke anticipated. Move container from fire area if no risk. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. Use unmanned hose holder or monitor nozzle. Note that addition of water to any spilled product may cause a vigorous reaction.

SPILL RESPONSES

General Information: May be best to delay cleanup until arrival or instruction of qualified radiological response team. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Prevent product from entering sewers or confined spaces. Protect sewers and waterways from contaminated runoff. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account while planning the response that uranium hexafluoride is highly toxic and corrosive, that contact with water may evolve hydrofluoric acid in a vigorous reaction, and that this corrosive acid may generate hydrogen gas in contact with some metals. Use explosion-proof and spark-proof equipment where necessary.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow airborne contaminants to dissipate. Uranium hexafluoride spills may expose downwind areas to toxic concentrations over considerable distances, particularly if there is contact of the product with water or moist air.

CONSEQUENCE

Avoidance of exposure. Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow dusts ,fumes, and vapors to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

URANIUM HEXAFLUORIDE
Class 7 (Radioactive Material)

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid uranium hexafluoride with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY. . . Water fog or spray applied to uranium hexafluoride vaporsfumes, or dusts may absorb vapors, knockdown fumes, and accelerate their dispersal in the atmosphere. Apply water at a point downwind of the spill. Do not allow water to contact spilled product on ground.

CONSEQUENCE

Water runoff may contain various chemicals.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Uranium hexafluoride may be contained by building dikes using dry earth, soil, sand or other materials.

CONSEQUENCE

Liquid solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. Reinforce diked walls as needed. Keep spilled solid as dry as possible.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product.

TECHNIQUE

NEUTRALIZATION . . . Application of an appropriate neutralization agent may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents involves additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques.

URANIUM HEXAFLUORIDE
Class 7 (Radioactive Material)

TECHNIQUE

MECHANICAL REMOVAL... Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers, and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Excessive agitation may cause toxic dust to become airborne.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Organize work to minimize dust generation.

WATER SPILL

TECHNIQUE'

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES. . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

NEUTRALIZATION . . . Application of a suitable neutralization agent to the contaminated water may reduce environmental hazards.

CONSEQUENCE

Some neutralizing agents are themselves hazardous and must be handled with care. Improper application may lead to increased damage or harm.

MITIGATION

Consult qualified experts for safe neutralizing techniques. Consider treating water via a processing system constructed on land.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier- than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic vapors if exposed to the open air.

MITIGATION

Consult qualified experts for guidance.

January 1991

UREA
Non-Regulated

GENERAL INFORMATION

Urea is not designated as a hazardous material in transportation but nevertheless has potential to cause injury and/or environmental pollution if improperly handled. It is consistently ranked among the top 15 chemicals produced in the United States and may therefore be encountered comparatively frequently in transportation or other accidents resulting in a chemical discharge.

Urea is usually shipped as solid white crystals, powders, prills or pellets, or as clear liquid water solutions containing 50 to 80% urea by weight. It is essentially odorless but may develop a slight odor of ammonia upon long standing, especially in the presence of moisture or humid air. The product is used as a fertilizer and animal feed ingredient, for making plastics, glues, pharmaceuticals and other products, as a stabilizer in explosives, and for separation of hydrocarbons. Solid forms are soluble in water and heavier; solutions will mix freely with water in all proportions.

The flammability hazard of solid urea is not defined as well as might be desired. The product does not meet shipping criteria for designation as a combustible or flammable material and is clearly not flammable under most conditions. This is reflected by the fact that the majority of data sources list the product as nonflammable. There are indications, however, that urea dust will burn under certain circumstances. At least one authority claims that the dust (presumably dispersed in air) can explode if ignited, especially if heated, while another claims this is unlikely. It appears that a possibility exists for well-sealed containers of the solid to rupture if exposed to excessive heat due to the generation and buildup of gases resulting from thermal decomposition of the product. Similarly, excessive heat may possibly have the potential to cause sealed containers of solutions to rupture due to excessive steam pressure.

Urea does not react with water or other common materials and is stable in normal transportation, though the solid will absorb moisture from the atmosphere if exposed to humid air. Reactions with a variety of other chemicals, however, are known to be explosive or otherwise violent. Toxicity of the product is generally low by all routes of exposure but products of thermal decomposition and/or combustion include several that are highly toxic and may provide cause for consideration of a downwind evacuation or alternative protective action if evolved into the atmosphere.

Due to various factors, the data and information found for this substance, although considerable in volume, contained numerous inconsistencies and shortcomings. It should not be expected that each and every item of information presented below is completely accurate.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Approx 78 g/100 g water at 41°F (5°C); 112.4 g/100 g water at 68°F (20°C); 119.3 g/100 g water at 77°F (25°C); solutions of urea in water are soluble in all proportions.

Solubility in Other Chemicals: Soluble in acetic acid, alcohol, benzene, glycerol, hydrochloric acid, and pyrimidine.

Specific Gravity: 1.323 - 1.340 for solid urea; 1.147 for saturated solution; 1.145 for 50% water solution; 1.054 for 20%; 1.027 for 10%; all at 68°F (20°C).

Boiling Point: Both the solid and even apparently water solutions decompose upon heating prior to boiling; see melting point.

Melting Point: Solid melts at about 270.9 °F (132.7°C). Higher temperatures or combustion may produce carbon monoxide, carbon dioxide, toxic oxides of nitrogen and possibly highly toxic hydrogen cyanide according to some sources.

Freezing Point: See melting point

Molecular Weight: 60.06

Heat of Combustion: -2174 cal/g

Vapor Pressure: Essentially zero for pure urea at 68°F (20°C) in the absence of conditions which cause evolution of ammonia gas.

Flash Point: Not applicable

Autoignition Temperature: Not available

Burning Rate: Not applicable

Stability: Stable in normal transportation.

Corrosiveness: Reported only to cause deterioration of unplasticized polyvinyl chloride (PVC) upon long-term use.

Reactivity with Water: No reaction. The pH of a 10% water solution is 7.2, which is close to neutral.

Reactivity with Other Chemicals: Urea reacts with calcium hypochlorite or sodium hypochlorite to form nitrogen trichloride which may explode spontaneously in air; mixtures with sodium nitrite may explode; mixtures with nitric acid may explode when heated; mixtures with chromyl chloride or nitrosyl perchlorate are reported to ignite; may form explosive mixtures subject to spontaneous detonation when contaminated with strong acids (e.g., nitric acid or perchloric acid) or nitrate fertilizers.

IDENTIFICATION

Shipping Names: No particular name is standard but "Chemicals, n.e.c. (non-regulated)" is one possibility. The shipper may or may not provide the specific chemical name of the product.

Synonyms and Tradenames: Amide of carbonic acid; carbamide; carbonyldiamide; carbonyldiamine; carbamimidic acid; isourea; and numerous tradenames.

Chemical Formula: NH_2CONH_2

Constituent Components (% each): Several grades of solid urea are available; most are likely to be 95% or more pure. Solutions in water typically contain 50 to 80% urea by weight.

28 STCC: 28 181 70 (for urea, other than liquor or liquid); 28 181 46 (for urea liquor or urea liquid)

UN/NA Designation: Not established

IMO Designation: Not established

Physical State As Shipped: Solid crystals, powders, prills, or pellets; liquid solutions in water

Physical State As Released: Same as shipped

Color of the Shipped Material: White solid or clear liquid

Odor Characteristics: Urea is essentially odorless but may develop a slight odor of ammonia upon long standing, especially in the presence of moisture or humid air.

Common Uses: Fertilizer; animal feed ingredient; making of resins, plastics, glues, solvents, cosmetics, dentrifrices, flameproofing agents, paper coatings, pharmaceuticals, and other chemicals.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

UREA
Non-Regulated

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: Odorless unless conditions are appropriate for evolution of ammonia gas; any formaldehyde present as an impurity may potentially produce an odor. See the separate Emergency Action Guides provided for these substances for further details.

Unusual Hazards: Reactions with a number of relatively common chemicals in commerce can result in fire, explosion, or other violent action. Solid urea becomes quite slippery when wet.

Short Term Exposure Limit (STEL): Not established

Time Weighted Average (TWA) Limits: 10 mg/ml (total dust) over each 8 hours of a 40 hour work week (ACGIH TLV, 1990 - 91); 15 mg/m^3 (as total dust) and 5 mg/m^3 (as respirable fraction) under similar circumstances (OSHA PEL, 1989); all as exposure limits for "nuisance dusts".

Conditions to Avoid: Generation of airborne dust or mist; contact with incompatible materials; entry or runoff to sewers or water bodies; inhalation, ingestion or direct physical contact; excessive heat or contamination of any kind.

HEALTH HAZARDS

Public Health Hazards: Opinions of various authorities range from "no real hazard" to "moderately toxic by inhalation and contact". Note that urea is a natural product of human protein metabolism and is a major component of urine. Adult male humans excrete about 30 grams of urea per day. The primary hazard of the product is the irritation it may cause to bodily tissues under appropriate circumstances. Toxic products of combustion or thermal decomposition are likely to be of far greater concern if generated.

Hazards of Skin or Eye Contact: Prolonged or repeated contact of the skin with solid urea may result in mild redness, rash, itching, and/or inflammation; contact with the heated material can cause thermal burns. Animal experiments with ointments containing 10 20 and 40% urea by weight somewhat suggest that water solutions of urea are unlikely to cause significant irritation of the skin. One reference reports that urea may cause allergic skin reactions in some individuals, but it appears this is mostly a problem with prills of urea containing a urea-formaldehyde binder that may sensitize some people and cause allergic reactions in subsequent exposures. Exposure to urea does, however, have the potential to increase the probability of skin sensitization to epoxy resins if these should be encountered. The dust of urea is irritating to the eyes but damaging only at high concentrations or with extended exposure. Unspecified but apparently high concentrations of solid urea dust or powder placed in the eye have been shown to cause corneal opacification (clouding) that has required up to several weeks to clear. Exposure of the eyes to saturated urea solutions may cause loss of the corneal epithelium after several minutes contact and produce moderate grayness of the stroma with subsequently slow but apparently complete regrowth of the membrane. Drops of 10% urea solutions in the eye do not cause eye irritation or discomfort. It is recommended by more than one maker of the product that contact lenses not be worn when working with this chemical.

Hazards of Inhalation: High levels of urea dust or mist in air are reported to cause irritation of the nose, throat, and respiratory tract with effects including sore throat, sneezing or coughing, and shortness of breath. Asthmatics exposed to the dust (and presumably mists) may have difficultly in breathing. Exposure to high concentrations of urea in air in long-term occupational exposures has been reported to cause emphysema.

Hazards of Ingestion: Urea is reported to be of low oral toxicity. Ingestion of significant quantities of the product may result in sore throat and gastrointestinal disturbances such as irritation, nausea, vomiting, cramps, abdominal pain, and diarrhea. Relatively large quantities may be fatal. The oral LD50 for rats, the single dose that proves fatal to 50% of the animals, has been reported to range from 8.5 to 15 g/kg of body weight; that for sheep and goats is in the range of 300 to 600 mg/kg in single oral doses but it has been reported that ruminant animals develop tolerance to urea when fed gradually increasing doses.

FIRE HAZARDS

Lower Flammable Limit: Unavailable
Upper Flammable Limit: Unavailable

Behavior in Fire: Urea does not meet shipping criteria for designation as a combustible or flammable material and is clearly not flammable under most conditions. Most data sources list the product as not flammable. One major authority reports, however, that urea dust will burn but will probably not explode (presumably if dispersed in a cloud of dust) while another reports that the dust can indeed be an explosion hazard, especially if heated. Although the hazard is not reported in the literature, it is conjectured that exposure of well-sealed containers to excessive heat may possibly cause decomposition of the solid product and generation of sufficient chemical gases and/or steam pressure (in the case of solutions) to cause rupture of the container. The rupture may take place with violence if the container is of strong construction (such as a metal drum). The solid product will melt and decompose at high temperatures; solutions are also subject to decomposition.

Hazardous Combustion Products: Most authorities report that decomposition of urea at temperatures at or above about 275°F results in generation of ammonia, biuret, and cyanuric acid. One adds that ammelide and triuret may also be formed. Higher temperatures or combustion may produce carbon monoxide, carbon dioxide, highly toxic oxides of nitrogen, and possibly highly toxic hydrogen cyanide gases according to some sources. Data on this topic are not entirely consistent. Little information is available on the toxicity of several of the more unusual products of decomposition and/or combustion.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable
Upper Explosive Limit: Unavailable

Explosiveness: Urea may explode in contact with various other chemicals. Authorities appear to disagree as to whether urea dust poses an explosion hazard, presumably when dispersed in air. Be advised there is a possibility it may be explosive, especially when heated. See Behavior in Fire section directly above for a discussion of container rupture potential.

UREA
Non-Regulated

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of eye contact and repeated or prolonged skin contact with the spilled product. This may include rubber boots, gloves, face shields, tight-fitting dust or splash-proof safety goggles as needed, and other appropriate protective clothing such as coveralls, aprons, long-sleeved shirts, and so forth. Compatible materials may include natural rubber, neoprene, nitrile rubber, polyvinyl chloride, and nitrile rubber/polyvinyl chloride according to one prominent authority. See the section on "Corrosiveness" also. Be advised that urea solutions can degrade leather.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations of dusts or mists in air, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For other conditions in which exposures may occur, a NIOSH approved dust or mist respirator appropriate for the airborne contaminant levels present within the use limitations of these devices. Note that no protection may be necessary if the product has spilled in a non-fire situation and dusts or mists have not become airborne.

FIRST AID

Nonspecific symptoms: Irritation of any bodily tissues; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water or soap and water. Get medical attention if eye or skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer large quantities of water immediately. Do not attempt to make the victim vomit. Get medical attention immediately. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration into the lungs and then repeat administration of water.

FIRE RESPONSE

Extinguishing Materials: Most fire extinguishing agents may be used in fires involving urea according to various authorities.

Extinguishing Techniques: Stay upwind. Avoid bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Use professional judgment to decide if sealed metal drums or other containers or tanks exposed to excessive heat or fire should be kept cool via use of water sprays to avoid the possibility of container rupture due to buildup and pressurization of gases or steam in the container. If deemed necessary, use water from side and from safe distance to keep containers cool until well after fire is out. For a massive fire in the cargo area under these circumstances, it may be prudent to use unmanned hose holders or monitor nozzles. In any case, stay away from ends of tanks involved in fire (especially of solutions), but realize that shrapnel may travel in any direction. See earlier discussions about the decomposition of urea at elevated temperatures.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel away from spill area. Avoid contact with spilled product. Eliminate ignition sources to be safe, including sources of sparks where significant concentrations of urea dust may be airborne. Stop discharge if safe to do so. Prevent substance from entering sewers and water bodies. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage or other hazard to boilers or industrial process equipment. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Keep the solid product dry if practical to avoid spread of contamination. It may be advisable to keep the solid product in tightly closed containers to avoid absorption of water from the atmosphere.

Consult environmental authorities for advice with respect to disposal options and the need to apply the individual land and water spill containment and cleanup techniques described below. Urea will not present a significant environmental hazard in some cases, particularly if it is sufficiently diluted. Many grades of the solid and its solutions are widely used or are suitable for use as agricultural fertilizers and may either be recovered or simply spread out over soil at suitable rates (e.g., 200 to 400 kg/ha; 180 to 360 lb/acre) when conditions are appropriate. Similarly, routing of solutions to a sewage plant after further dilution may be appropriate at times. Be advised, however, that urea can be toxic to fish when present in water in relatively high concentrations. Any ammonia in the product can be toxic to fish at very low concentrations. As a fertilizer, urea can abet eutrophication of water bodies since it is a source of nitrogen in water. Concentrations in the range of 1 to 15 ppm of the product were found to completely degrade to ammonia and carbon dioxide, and eventually nitrate, in about 4 to 6 days in river water in one experimental observation at a temperature of 68°F (20°C); degradation rates were negligible when the water temperature was less than about 46°F (8°C). The product will degrade in standard sewage plants at rates dependent on temperature of the water, with higher temperatures enhancing degradation. Urea is typically found in domestic sewage in concentrations of 2 to 6 ppm. The product can be tasted in water in concentrations as low as 3 ppm.

UREA
Non-Regulated

AIR SPILL

TECHNIQUE

MONITOR THE SITUATION . . . Urea and its solutions in water will not evolve significant amounts of hazardous airborne contaminants in most non-fire spill situations. It may be advisable in many cases to simply monitor the situation until the spilled product is removed. (Note: In order to pose a significant downwind inhalation hazard, large quantities of urea dusts or mists must somehow become airborne; conditions must be appropriate to generate significant quantities of ammonia gas; and/or toxic products of thermal decomposition or combustion must be generated.)

CONSEQUENCE

Hazardous levels of urea or other chemicals may possibly be found in air in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Remove unprotected personnel from the local spill area and areas immediately downwind.

TECHNIQUE

PROTECTION FROM WIND . . . If necessary, cover solid urea with a plastic sheet or other compatible material to prevent airborne dust or contact with water. Remove spilled product as soon as possible.

CONSEQUENCE

Cover material will become contaminated.

MITIGATION

Handle cover material with care during site cleanup. Dispose or decontaminate properly.

TECHNIQUE

WATER FOG OR SPRAY . . . Where necessary, water fog or spray applied to urea dusts or mists in air may knock them down and accelerate their dispersal in the atmosphere. Apply water at a point downwind if practical if solid urea is exposed to prevent dissolution in water and spreading of contamination.

CONSEQUENCE

Water runoff may contain some amounts of urea and other chemicals from contact with its dusts or mists.

MITIGATION

Contain contaminated water where deemed necessary and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire-hose runoff or rainwater that may add to spill volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Urea and its solutions may be contained by building dikes or barriers using soil, sand or other compatible materials. Storm drains and sewer openings may be sealed using compatible plastic or rubber sheeting covered with rocks and soil or sand, or via other appropriate methods.

CONSEQUENCES

Contained solutions may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Keep solid urea dry to the extent possible. Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product, particularly solutions.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

UREA
Non-Regulated

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with the spilled product.

TECHNIQUE

ABSORPTION . . . Spreading of solutions may be controlled by absorbing the liquid with sand, earth, clay, vermiculite, perlite, commercial sorbents, or other compatible substances according to various authorities.

CONSEQUENCES

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Note that noncombustible sorbents are preferred in order to reduce the hazard in the event of afire.

TECHNIQUE

NEUTRALIZATION . . . Where deemed necessary, application of an appropriate neutralization agent to solutions of urea in water may modify the spilled product to a less hazardous substance.

CONSEQUENCE

Application and removal of chemical agents entail additional environmental risks.

MITIGATION

Consult qualified experts for safe neutralization techniques. Consult environmental officials about the need for neutralization.

TECHNIQUE

MECHANICAL REMOVAL . . . Where deemed necessary, contaminated soil and spilled product or its residues may be removed by brooms, shovels, motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Improper removal techniques may cause urea dusts to become airborne. Use of may possibly result in heating and ignition of urea dust under appropriate conditions.

MITIGATION

Select removal procedures that do not cause urea dusts to become airborne. Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Apply caution if using any equipment that may result in heating and possible ignition of urea dust. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination. Solid urea will sink in water and dissolve at a fairly rapid rate, particularly if water is plentiful compared to the amount of urea spilled. Solutions of the product will dissolve freely in water.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

UREA
Non-Regulated

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water solids that have not dissolved and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged.

MITIGATION

Consult qualified experts for guidance.

September 2006

VINYL ACETATE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Vinyl acetate is a colorless and fairly volatile liquid with a pleasant, sweet, and fruity odor. It is used to make plastics and resins for adhesives, paints, lacquers, films, safety glass, paper coatings, textile finishes, and chewing gum. It is only slightly soluble in water and somewhat lighter, so may be expected to form a floating surface slick that slowly dissolves. Its flash point of 18°F indicates that the product may be easily ignited under a wide range of ambient temperature conditions. Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back under appropriate conditions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 7.8 pounds per gallon.

Vinyl acetate does not react with water or many other common materials and is stable in normal transportation. Exposure to excessive heat, light, peroxides, or oxidizing agents, however, may initiate self-polymerization resulting in violent container rupture. The product is otherwise reactive with a variety of chemicals. Toxicity is low to moderate by the various potential routes of exposure and the product is primarily considered an irritant. Products of combustion include acrid fumes and possibly other toxic substances.

If vinyl acetate is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 2.3 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, chloroform, and ether.

Specific Gravity (Liquid): 0.934 at 68°F (20°C)

Vapor Density: 3

Boiling Point: 163.2°F (72.9°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: –135°F (–92.8°C)

Molecular Weight: 86.09

Heat of Combustion: –5419 cal/g; –495 Kcal/mole

Evaporation Rate (butyl acetate=1): 8.89

Vapor Pressure: 90 mmHg (1.74 psia) at 68°F (20°C)

Flash Point: 18°F (–7.8°C), closed cup; 23°F (–5°C), open cup

Autoignition Temperature: Reports vary from 725 – 800°F (385 – 427°C)

Burning Rate: 3.8 mm/minute

Flammable (Explosive) Limits: 2.6% (LEL) – 13.4% (UEL)

Stability: Stable, but may polymerize under conditions described below.

Polymerization Potential: May occur when exposed to heat, light, peroxides, high temperatures or oxidizing agents.

pH: Not applicable

Corrosiveness: Generally not corrosive when free of moisture. May be corrosive to copper and its alloys.

Reactivity with Water: No reaction

Reactivity and Incompatibility: Peroxides and strong acids may initiate polymerization under extreme conditions. Also reacts with strong bases, oxidizing materials, 2-amino ethanol, ethylene diamine, ethylene imine, silica gel, alumina, azo compounds and ozone.

IDENTIFICATION

Shipping Names: Vinyl acetate, stabilized (USDOT & IMO)

Synonyms and Tradenames: Acetic acid ethenyl ester; Acetic acid ethenyl ether; Acetic acid vinyl ester; Acetoxyethene; 1-Acetoxyethylene; Ethenyl ethanoate; Ethenyl acetate; VAM; Vinyl acetate monomer; Vinyl ethanoate; VAC; Vinyl a monomer; vyac; zeset T

CAS Registry No.: 108-05-4

Chemical Formula: $CH_3COOCH=CH_2$

Constituent Components (% each): 99.8% pure with small amounts of hydroquinone and/or diphenylamine as inhibitors.

UN/NA Designation: UN1301

IMO Designation: 3, flammable liquids

RTECS Number: AK0875000

NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 2 (Instability)

Physical Form as Shipped: Liquid

Physical Form as Released: Liquid

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant, fruity, sweet, like ether

Reportable Quantity: See Appendix I

Common Uses: Mfg. plastics and resins for adhesives, paints, lacquers, films, safety glass, coatings, textile finishes, and bases for chewing gum.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

VINYL ACETATE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.12 – 0.5 ppm

Unusual Hazards: Fairly volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back. Polymerization resulting in container rupture may occur (see Chemical/Physical Data section). Vapors are uninhibited and may form polymers in vents and flame arrestors resulting in stoppage. Several sources list the material as a possible carcinogen and is toxic to aquatic organisms.

Short Term Exposure Limits (STEL): 15 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 10 ppm over each 8 hours of a 40 hour work week. (ACGIH)

Ceiling (C) Limit: 4 ppm (15 mg/m^3) (NIOSH)

IDLH: Not determined

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact; exposure to penetrating electromagnetic radiation.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from exposure to the high vapor concentrations that may be present in the spill area and downwind. Ingestion and physical contact are also to be avoided.

Hazards of Skin or Eye Contact: Prolonged or repeated contact of liquid vinyl acetate with the skin may result in drying, cracking, inflammation and blistering. Contact with the eyes may cause irritation and temporary eye injury.

Hazards of Inhalation: Vapors of vinyl acetate may be irritating to the eyes, nose, and respiratory tract. High concentrations in air may cause narcosis and central nervous system depression with symptoms including incoordination, drowsiness, confusion, and possibly depression of the respiratory system.

Hazards of Ingestion: Moderately toxic. Ingestion may result in headache, drowsiness, vomiting, stomach pain, emotional disturbances, loss of coordination and unconsciousness. Large amounts may be fatal.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 2.6%

Upper Flammable (Explosive) Limit: 13.4%

Behavior in Fire: Flammable liquid. May generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire or excessive heat may result in polymerization and violent container rupture.

Hazardous Combustion Products: May include acrid fumes, carbon monoxide, and other toxic substances.

EXPLOSION HAZARDS

Explosive Potential: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Excessive heat or light may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in the presence of peroxides or strong acids.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

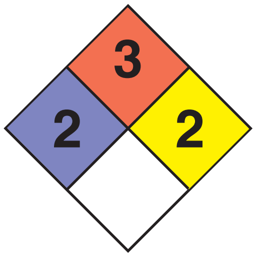
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® BR; Tychem® LV; Tychem® TK; Tychem® Reflector®; Tychem® ThermoPro; Teflon® (gloves, suits, boots); Barricade® coated suits; 4H® and Silver Shield® brand gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Tychem® Responder®. The following materials are ***not*** recommended for use: natural rubber; neoprene; nitrile rubber; Tychem® CPF 2; Tychem® SL; Tychem® CPF 4; Tychem® F.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 4000 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 4000 ppm), any supplied-air respirator* operated in a pressure-demand or other positive-pressure mode. For lesser concentrations (below 200 ppm): any air-purifying full-facepiece

1301

VINYL ACETATE

Class 3 (Flammable Liquid)



respirator equipped with organic vapor cartridge(s); any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; any powered air-purifying respirator* with a tight-fitting facepiece and organic vapor cartridge(s); any supplied-air respirator with a full facepiece; or any self-contained breathing apparatus with a full facepiece. For lesser concentrations (below 100 ppm): any supplied-air respirator* operated in a continuous-flow mode; or any powered air-purifying respirator with organic vapor cartridge(s). Note: Respirators noted with (*) may require eye protection.

FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, nose, or respiratory tract; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 20 minutes. Get medical attention immediately if irritation persists after washing.

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

Note to Physician: Consider gastric lavage and activated charcoal slurry.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, alcohol-resistant foam, water spray. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Vinyl acetate may float on water and slowly dissolve. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable vapors. Note that vinyl acetate has a flash point of 18°F.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of vinyl acetate may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that vinyl acetate is a highly volatile and flammable liquid that floats on water and will slowly dissolve. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

VINYL ACETATE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Vinyl acetate may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of vinyl acetate in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vinyl acetate vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain vinyl acetate from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

ALCOHOL-RESISTANT FOAM . . . There is a possibility that alcohol-resistant foam applied to the surface of liquid pools may slow the release of vinyl acetate vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase.
Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Vinyl acetate may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained vinyl acetate may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

VINYL ACETATE

Class 3 (Flammable Liquid)

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, commercial sorbents or other compatible substances. Do not use combustible materials.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6 – 8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed.

VINYL ACETATE
Class 3 (Flammable Liquid)

Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating vinyl acetate.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with vinyl acetate may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination. Note: Not much vinyl acetate is expected to dissolve, however, other techniques may be considered, such as Adsorption and Aeration, to remove any dissolved material.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

August 1996

VINYL BROMIDE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Vinyl bromide is a liquefied, highly flammable colorless gas with a pungent odor. Under normal atmospheric conditions, it exists as a gas, and under pressure, it is a liquid. Vinyl bromide can be produced by the catalytic addition of hydrogen bromide to acetylene in the presence of mercury and/or copper halide catalysts, or by partial dehydrobromination of ethylene dibromide with alcoholic potassium hydroxide. It may also be produced from the reaction of 1,2-dibromoethane with hot, aqueous sodium hydroxide. Vinyl bromide is primarily used in polymers as a flame retardant in the production of fibers for carpet backing material, and in the production of plastics. It is also copolymerized with vinyl acetate and maleic anhydride to produce granular products, and it is used in leather and fabricated metal products. Vinyl bromide has relatively low acute toxicity, however, because of its chemical similarity to vinyl chloride, it would be expected to show similar chronic effects at similar exposure levels. It may be toxic if inhaled or absorbed through the skin. In high concentrations, it may produce dizziness, disorientation, and narcosis. The material may polymerize upon exposure to sunlight. Rapid evaporation of the liquid may produce frostbite-type injury to the skin upon contact. The most common routes of exposure are through inhalation and skin contact. Vinyl bromide is an ACGIH (A2) suspected human carcinogen.

The fire potential for vinyl bromide is high. Heating can release highly toxic fumes of the bromide ion. The material can react violently with oxidizing agents. Vapors are heavier than air and may settle in low lying areas to form explosive mixtures with air above its flash point. Vapors may travel considerable distances to an ignition source and flash back. Normal structural firefighting protective clothing will not provide an adequate level of personal protection for personnel working in contaminated atmospheres. Runoff may flammable and/or toxic. Vinyl bromide is not water soluble. Empty containers containing product residue may be hazardous and proper safety precautions should be followed.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Not soluble.
Solubility in Other Chemicals: Chloroform, ethanol (10%), ethyl ether (10%), acetone (10%), and benzene (10%).
Specific Gravity (Liquid): 1.5 @ 20°C (68°F)
Vapor Density (Air=1): 3.7
Boiling Point: 16°C (61°F)
Melting Point: -139°C (-95°F)
Freezing Point: Unavailable.
Molecular Weight: 106.96
Heat of Combustion: Unavailable.
Evaporation Rate: Unavailable.
Vapor Pressure: 895 mm Hg at 20°C (68°F)
Flash Point: <-8°C (<18°F)
Autoignition Temperature: 530°C (986°F)
Flammable Limits: 9.0% (LEL) - 15.0% (UEL)
Stability: Unstable.
Polymerization Potential: Will polymerize immediately when exposed to sunlight, in the presence of air, or if inhibitor is lost.
Reactivity and Incompatibility: Can react violently with oxidizing agents.
Other Characteristics: Can generate toxic and hazardous fumes of the bromide ion when exposed to heat and flames.

IDENTIFICATION

Shipping Name(s): Vinyl bromide, stabilized (USDOT & IMO)
Synonyms and Tradenames: Bromoethene, Bromoethylene, Ethene, Bromo-, NCI-C50373, Monobromoethylene. CAS Registry No: 593-60-2
Chemical Formula: C_2H_3Br
Molecular Formula: C_2H_3Br
UN/NA Designation: UN1085
IMO Designation: 2.1
RTECS Number: NIOSH/KU8400000
OHMTADS Number: 7217315
NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 1 (Reactivity)
Physical Form as Shipped: Liquid under pressure
Physical Form as Released: Gas/liquid
Color of the Shipped Material: Colorless
Odor Characteristics: Pungent, pleasant odor.
Common Uses: Vinyl bromide is primarily used in polymers as a flame retardant in the production of fibers for carpet backing material, and in the production of plastics. It is also copolymerized with vinyl acetate and maleic anhydride to produce granular products, and it is used in leather and fabricated metal products.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR INCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

VINYL BROMIDE

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: None established.

Unusual Hazards: ACGIH (A2) Suspected Human Carcinogen.

Time Weighted Average (TLV-TWA): 5 ppm.

Short Term Exposure Limit (STEL): Unavailable.

IDLH: Unavailable.

Conditions to Avoid: Exposure to sunlight, oxygen, and potential ignition sources such as heat, sparks, flame, impact, friction, static electricity.

HEALTH HAZARDS

Potential Health Effects: Vinyl bromide has relatively low acute toxicity, however, because of its chemical similarity to vinyl chloride, it would be expected to show similar chronic effects at similar exposure levels. These symptoms include: eye and respiratory tract irritation, and central nervous system (CNS) depression with nausea, vomiting, dizziness, disorientation, drowsiness, narcosis, incoordination and unconsciousness. Vinyl bromide is a suspected human carcinogen. Individuals with pre-existing conditions of the central nervous system or lungs may have increased susceptibility to the toxicity of excessive exposures.

Hazards of Skin Contact: Skin contact may cause skin irritation with rash, redness, and swelling. Rapid evaporation of the liquid may cause frostbite-type injury upon contact. Prolonged exposures may lead to skin burns, blistering and dermatitis.

Hazards of Eye Contact: Eye contact with liquid or vapors may cause irritation, redness, swelling, tearing, chemical conjunctivitis, burns, or blurred vision.

Inhalation Hazards: Inhalation may cause irritation to the upper respiratory passages, and mucous membranes, pulmonary edema, wheezing, and dyspnea. Prolonged exposures can produce central nervous system (CNS) effects such as nausea, headache, vomiting, dizziness, disorientation, drowsiness, narcosis, incoordination and unconsciousness.

Ingestion Hazards: Ingestion may cause irritation of the mucous membranes and respiratory tract, followed by headache, nausea, vomiting and abdominal pain.

FIRE HAZARDS

Lower Flammable Limit: 9.0%

Upper Flammable Limit: 15.0%

Behavior in Fire: Vinyl bromide is a highly flammable gas. It will readily ignite if exposed to sources of heat and flame. Vapors are heavier than air, may travel along the ground, and settle in low lying areas to form explosive mixtures with air. Vapors may travel to distant ignition sources and flash back. Vapors may also be affected by ventilation and ignited by heat, pilot lights, static electricity, and other potential ignition sources at locations distant from the point of release. Runoff may be flammable and/or toxic.

Hazardous Decomposition Products: When heated to decomposition, material releases highly toxic and hazardous fumes of the bromide ion.

EXPLOSION HAZARDS

Explosive Potential: High. Welding, cutting or grinding of empty containers should be avoided due to the possibility of ignition of residue. Prevent material and runoff from entering sewers, storm drains and other enclosed areas due to the potential for an explosion. Vinyl bromide will polymerize immediately when exposed to sunlight, or if the inhibitor is lost, or if kept in the presence of oxygen or air.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

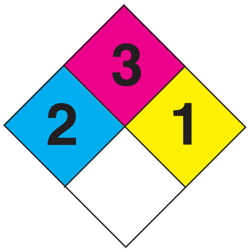
Protective Clothing Requirements: Emergency response personnel must wear specialized chemical protective clothing and equipment compatible with the material in uncontrolled release situations. Full encapsulating chemical vapor protective clothing (EPA Level A Protection) should be worn for spills and leaks with no fire. Suitable materials of construction are nitrile rubber and viton®. Structural firefighting protective clothing does not provide an adequate level of personal protection for this product.

Respiratory Protection: Positive-pressure self-contained breathing apparatus (SCBA) is the minimum level of respiratory protection recommended for uncontrolled release situations.

1085

VINYL BROMIDE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Skin contact with the escaping liquid may cause frostbite-type injury with redness, swelling, burning, and dermatitis. Excessive exposures may cause temporary central nervous system depression with anesthetic effects such as dizziness, drowsiness, nausea, headache, confusion, and loss of consciousness. Eye contact may result in corneal injury. Inhalation may cause irritation to the upper respiratory passages and mucous membranes with coughing, sore throat and discomfort.

First Aid for Inhalation: Immediately remove victim to an uncontaminated environment with fresh air. Remove any contaminated clothing. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered immediately. If the victim is breathing with difficulty, oxygen should be given. DO NOT ADMINISTER MOUTH TO MOUTH RESUSCITATION due to the possibility of chemical exposure. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Skin Contact: In case of skin contact, immediately remove contaminated clothing and flush the affected area(s) with water. Wash the area with soap and copious amounts of water or saline for at least 15 minutes. In case of frostbite, warm affected skin in warm water at a temperature of 107°F. If warm water is not available or impractical to use, gently wrap affected area(s) in blankets. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: In case of eye contact, immediately flush eyes with copious amounts of tepid water or saline for at least 15 minutes, occasionally lifting the upper and lower eyelids. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Ingestion: If swallowed, immediately give two (2) glasses of water and INDUCE VOMITING. Never administer fluids if the victim is unconscious or having convulsions. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical, water spray (fog) or regular foam.

Extinguishment Techniques: Secure ignition sources in the immediate spill area and down wind. Approach release from upwind to avoid hazardous vapors and toxic decomposition products. Wear appropriate level of personal protective clothing and equipment. Water may be ineffective for fire control, however water spray may be used to cool fire-exposed containers, disperse vapors, and to protect personnel. Solid streams of water may be ineffective. Use water in flooding quantities as fog and fight fire from maximum distance. For massive fires in cargo area, use unmanned master stream devices. If this is not feasible, withdraw from the area and let the fire burn out. Withdraw from the area immediately in the event that rising sounds from venting safety devices are heard, or any discoloration of the tank shell is observed. Containers exposed to fire may rupture violently and travel considerable distances, therefore personnel should stay away from ends of containers. Dike fire control water for proper disposal since it may contain flammable and/or toxic gases.

SPILL RESPONSES

General Information: Vinyl bromide is a highly flammable gas that may cause environmental contamination. Do not walk through spilled material. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Non-sparking tools and explosion-proof equipment are recommended to minimize the potential for ignition. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Stop or control the leak if it can be accomplished without undue risk. Water spray may be used to reduce the generation of vapors. Prevent material from entering sewers, waterways, and storm rains. Overflow dams may be an effective means to dike material since it is not water soluble and it is heavier than water. Spills may be absorbed with sand, clay, sawdust, or other non-combustible absorbent material and shoveled into clean, dry containers and covered. Runoff may be flammable and/or toxic. All contaminated material should be treated as hazardous wastes and disposed of in accordance with applicable federal, state and local environmental regulations, and in consultation with technical specialists from the shipper/manufacturer. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. For example, liquid and vapors can saturate protective clothing and be carried off-site. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Use a massive rinse on the outer shell of protective clothing. Maintain respiratory protection throughout the decontamination process.

VINYL BROMIDE
Division 2.1 (Flammable Gas)

AIR SPILL

TECHNIQUE

EVACUATION...As a general precaution, isolate the area for 1/2 miles in all directions if a bulk container is involved. Consult with local officials to determine the extent to which evacuation or protection-in-place procedures may be warranted. Considerations include: the magnitude of the release, the potential exposures and their proximity to the source of the release, the potential for the release to migrate toward populated areas, the time of day, the resources available to assist in evacuation efforts, and the available locations to house evacuees.

CONSEQUENCE

Need to notify, organize, transport and house evacuees.

MITIGATION

Secure potential ignition sources such as of heat, sparks, flame, impact, friction or electricity in the immediate spill area and downwind. Do not walk through spilled material. Ventilate enclosed areas before entering. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Stop or control the leak if it can be accomplished without undue risk. Prevent runoff from entering sewers, waterways, and storm drains.

TECHNIQUE

MONITOR THE SITUATION...Vinyl bromide is expected to exist almost entirely in the vapor phase when released into the atmosphere. Based on its vapor pressure, the highest concentrations of material will usually be located at ground level. Depending on the magnitude of the release, flammable and/or toxic concentrations may take several hours to dissipate. The time frame would depend on the size of the release and atmospheric conditions. Continuous air monitoring of the immediate area and downwind should be conducted to monitor for the presence of hazardous concentrations of flammable and/or toxic vapors.

CONSEQUENCE

Hazardous concentrations of material may concentrate in the immediate spill area and downwind. Vapors may accumulate in low lying and enclosed areas.

MITIGATION

Evacuate the immediate area and down wind of the site of the release as conditions warrant and to allow vapors to dissipate. Personnel should conduct periodic air monitoring of the area to determine if flammable and/or toxic concentrations exist and when conditions are safe to reenter the area. Consult environmental specialists for assistance, as needed.

TECHNIQUE

WATER SPRAY OR FOG...Water sprays may be used reduce vapors. Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation.

CONSEQUENCE

Runoff may contain flammable and/or toxic concentrations of material.

MITIGATION

Contain contaminated runoff and remove as soon as possible to prevent the potential spread of contamination. In enclosed areas, runoff may add to spill volume and overfill impoundments. Prevent runoff from entering sewers, waterways and storm drains.

TECHNIQUE

FOAM...Aqueous Film Forming Foam (AFFF) or compatible hazardous materials foam agents may be applied to the surface of liquid pools.

CONSEQUENCE

The effects of foam application may be short term. As foam breaks down, or in high wind conditions, the integrity of the foam blanket may be compromised. A visible foam blanket on the surface of the liquid does not necessarily ensure an adequate level of vapor suppression.

MITIGATION

Continue foam application until spilled material is removed. Prevent runoff from entering sewers, waterways, and storm drains. Contain foam runoff and treat as hazardous waste and dispose of in accordance with applicable local, state and federal environmental regulations.

VINYL BROMIDE

Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE...Notify downstream industrial, municipal, and public water users to stop intake or monitor for contamination if material has entered sources of drinking water.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until primary water supply is declared safe.

TECHNIQUE

CONTAINMENT...If released into water sources, vinyl bromide should undergo volatilization. The time frame would depend on the size of the release and atmospheric conditions. Contaminated water may be contained or flow diverted by diking the upper and lower bounds to limit the spread of contamination and volume of water affected. Clean water can be diverted around contaminated impoundments by excavation of diversion channels.

CONSEQUENCE

Dikes may fail over time due to saturation and erosion in the vicinity of the diversion structure.

MITIGATION

Monitor dikes and diversion structures for integrity and reinforce as necessary. Arrange to remove impounded, contaminated water as soon as possible.

TECHNIQUE

DIVERSION...Material is not water soluble. Overflow dams may be used to confine or divert the spill to a limited area until the material volatizes.

CONSEQUENCE

Some material will likely continue to migrate down stream despite containment measures. Water-borne releases will be difficult to contain since measures are not 100% effective.

MITIGATION

The integrity of dams and dikes should be monitored periodically since they may fail over time. Monitor down stream users and test for signs of contamination. Water sprays may be used to control the generation of vapors. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas.

TECHNIQUE

FLOATING BOOMS/BARRIERS...Booms may be an effective means to recover spilled material since the material is not water soluble. Barriers of suitable material may be used to confine the spill to a limited area and prevent migration down stream.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

SURFACE SKIMMING...Surface skimming may be effective since the material is not water soluble and it is heavier than water.

CONSEQUENCE

Some material will likely travel beyond barriers and down stream. The rate of migration will depend on the size of the release and atmospheric conditions.

MITIGATION

Confine the spill as quickly as possible using barriers to prevent possible contamination beyond the spill area. Recover spilled product as soon as possible. Use compatible equipment for clean-up operations. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

VINYL BROMIDE
Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES...If released to soil, material may rapidly evaporate or undergo extensive leaching (moist soil), possibly contaminating ground water supplies. Spills of material may be contained by building dikes or barriers using soil, sand, or other related materials. Where liquids are likely to come in contact with water from runoff or rain, containment barriers can be used to prevent the flow of contaminated runoff or block water from contacting spilled material. Containment dikes may be effective to prevent the migration of the spill so that excavation of the contaminated area can be completed, or confine or divert the spill to a limited area until the material volatizes or biodegradation occurs.

CONSEQUENCE

Material is mobile in soil and may seep through dike material, which may result in loss of product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Use compatible equipment for clean-up operations. The integrity of dikes should be monitored periodically since they may fail over time. Water sprays may be used to control the generation of vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. Runoff may be flammable and/or toxic. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

EXCAVATION...Spills of material may be contained by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for contamination of ground water in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Prevent spills and runoff from entering waterways, storm drains, and sewer systems. Use compatible equipment for clean-up operations. Water sprays may be used to reduce vapors, except in enclosed areas where runoff may accumulate and overflow impoundments. Runoff may be flammable and/or toxic. Be alert to conditions such as increasing spill volume with runoff or rain water which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Dispose of contaminated water as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

PUMPING/VACUUM SUCTION...Spilled material contained in diked areas may be recovered using compatible pumps, hoses and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

TECHNIQUE

MECHANICAL REMOVAL...Soil contaminated with spilled material may be removed by shovels, as well as a variety of heavy equipment such as backhoes and loaders.

CONSEQUENCE

Mechanical equipment used in clean-up operations may become contaminated and present a safety and/or health hazard to response personnel.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed.

September 2006

VINYL CHLORIDE

Division 2.1 (Flammable Gas)

GENERAL INFORMATION

Vinyl chloride is a colorless gas that is shipped under pressure as a liquid and has a pleasant, sweet odor. It is used for making plastics, resins, and other chemicals and also has uses as a refrigerant and solvent. It is slightly soluble in water and lighter, so may be expected to boil from the surface of a water body with only a small amount dissolving. Its very low flash point and boiling point temperature of 7.2°F indicate that the product may be easily ignited under all ambient temperature conditions and that large amounts of gas or vapor may be evolved from spills. Vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may result in explosions if ignited. There is also some known potential for explosions involving unconfined vapor clouds. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). The product weighs approximately 8.1 pounds per gallon near its boiling point.

Vinyl chloride does not react with water or many common materials and is stable in normal transportation. Exposure to air, sunlight, or excessive heat, however, may initiate self-polymerization leading to violent rupture of containers. The product also reacts with strong oxidizing materials. It is an irritant to the eyes, skin, and mucous membranes and is regarded to be a potent human carcinogen and a cause of angiosarcoma of the liver in long term occupational exposures. Contact with the liquid may cause frostbite type burns. Products of combustion may include highly toxic phosgene, hydrogen chloride, carbon dioxide and carbon monoxide gases.

If vinyl chloride is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 330 feet (100 meters) in all directions. If the spill is large, consider initial downwind evacuation for one-half (1/2) mile (800 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, isolate and consider evacuation for one (1) mile (1600 meters) in all directions for protection from flying debris if the container should rupture violently. There is a potential for containers to rupture if exposed to excessive heat or fire for sufficient time duration.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly, 1 g/100 g water at 68°F (20°C)

Solubility in Other Chemicals: Soluble in alcohol, hydrocarbons, oil, chlorinated solvents, ether, benzene, carbon tetrachloride and most organic liquids.

Specific Gravity (Liquid): 0.969 at 8.6°F (–13°C)

Vapor Density: 2.2

Boiling Point: 7.2°F (–13.8°C) at 1 atm.

Melting Point: See freezing point

Freezing Point: –244.8°F (–153.8°C)

Molecular Weight: 62.50

Heat of Combustion: –4520 cal/g

Evaporation Rate (butyl acetate=1): >1000

Vapor Pressure: 3.4 atm (49.9 psia) (2530 mmHg) at 68°F (20°C)

Flash Point: Approx. –110°F (–78.9°C), open cup

Autoignition Temperature: 882°F (472°C)

Burning Rate: 4.3 mm/minute

Flammable (Explosive) Limits: 3.6 – 4% (LEL) – 22 – 36% (UEL)

Stability: Stable, but may polymerize, see below.

Polymerization Potential: Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol.

pH: Not applicable

Corrosiveness: Not corrosive, but may corrode iron and steel if water present. Unsafe in contact with monel, copper and its alloys, and other acetylide forming materials (may form explosive compounds).

Reactivity with Water: No reaction

Reactivity with Other Chemicals: Reacts with copper, aluminum, peroxides, oxidizing materials and acetylide forming materials (see Corrosiveness section). Peroxides may initiate polymerization.

IDENTIFICATION

Shipping Names: Vinyl chloride, stabilized (USDOT & IMO)

Synonyms and Tradenames: Chloroethylene; 1-Chloroethylene; Chloroethene; Ethylene monochloride; Monochloroethene; Monochloroethylene; Monovinyl chloride; Vinyl C monomer; VC; Vinyl chloride monomer; VCM; VCL; MVC

CAS Registry No.: 75-01-4

Chemical Formula: CH_2=CHCl

Constituent Components(% each): 99% or more pure; may contain 40 – 100 ppm phenol as inhibitor

UN/NA Designation: UN1086

IMO Designation: 2.1, flammable gas

RTECS Number: KU9625000

NFPA 704 Hazard Rating: 2 (Health): 4 (Flammability): 2 (Instability)

PPhysical State as Shipped: Liquefied gas

Physical State as Released: Gas or liquid (boils at 7.2°F)

Color of the Shipped Material: Colorless

Odor Characteristics: Pleasant, sweet, ethereal

Reportable Quantity: See Appendix I

Common Uses: Mfg. plastics (polyvinyl chloride), resins, and other chemicals; refrigerant; solvent.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

VINYL CHLORIDE

Division 2.1 (Flammable Gas)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 250 – 3000 ppm; reported values vary.

Unusual Hazards: Extremely volatile and flammable substance. May violently polymerize if exposed to air, sunlight, or excessive heat. Vapors may travel considerable distance to a source of ignition and flash back. Vapors are heavier than air and may persist in pits and depressions. Product may be ignited by static discharge or flowing material.

Short Term Exposure Limits (STEL): Unavailable

Time Weighted Average (TLV-TWA): Potential occupational carcinogen (NIOSH); 1 ppm (OSHA)

Ceiling (C) Limit: 1 ppm (OSHA)

IDLH: Potential occupational carcinogen (NIOSH)

Conditions to Avoid: Heat, fire, or sparks; contact with air, sunlight, or incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the very high vapor concentrations that may be present in air in the spill area and over considerable downwind distances. Contact with the liquid is also to be avoided.

Hazards of Skin or Eye Contact: Contact of the skin with liquid vinyl chloride may cause irritation and frostbite. Contact with the eyes may result in immediate and severe irritation with the possibility of temporary injury.

Hazards of Inhalation: High concentrations of vinyl chloride in air may result in central nervous system depression with symptoms including headache, dizziness, light-headedness, nausea, dulling of visual and auditory senses, loss of consciousness, and possibly death. VCM has narcotic properties and can cause unconsciousness in concentrations of 20,000 ppm.

Hazards of Ingestion: Ingestion of liquid vinyl chloride is unlikely, but toxic effects and tissue damage would be expected.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 3.6 – 4%

Upper Flammable (Explosive) Limit: 22 – 36%

Behavior in Fire: Flammable liquefied gas. Will generate large quantities of flammable gas or vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Exposure of containers to fire or heat may result in violent polymerization.

Hazardous Combustion Products: May include highly toxic phosgene, hydrogen chloride, carbon dioxide and carbon monoxide.

EXPLOSION HAZARDS

Explosiveness: Containers may rupture violently in fire. Explosions may result if vapors are ignited in a confined area. Excessive heat, light, or air may cause spontaneous violent polymerization resulting in container rupture. Contact with acetylide forming materials like monel, copper, and copper alloys may form explosive compounds. There is a known potential for unconfined vapor clouds to explode if ignited.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

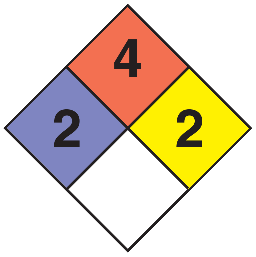
Protective Clothing Required: Equipment should prevent any reasonable probability of skin or eye contact with the spilled product. This may include rubber boots, gloves, face shields, gas tight goggles, and other impervious and resistant clothing providing protection from cold surfaces as well as direct contact with spilled liquid product. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 2; Tychem® SL; Tychem® CPF 3; Tychem® CPF 4; Tychem® BR; Tychem® Responder®; Tychem® Responder® CSM; Tychem® TK; Tychem® F; Tychem® Reflector®; Tychem® ThermoPro; Nitri Solve 727® gloves; Viton 890® gloves. The following materials are reported to have a greater than 4 hour breakthrough time: polyvinyl alcohol (gloves); Teflon® (gloves, suits, boots); Butyl 878 gloves.

Respiratory Protection: For unknown concentrations, fire fighting, or ***any detectable*** concentrations: any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

1086

VINYL CHLORIDE

Division 2.1 (Flammable Gas)



FIRST AID

Nonspecific Symptoms: Dizziness, headache, and other symptoms of inhalation.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of lukewarm water until circulation returns. Provide supportive care and seek immediate medical assistance by a physician from the nearest medical treatment facility. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination. (Note: Do not use hot water.)

First Aid for Eye Contact: Flush eyes immediately with water for at least 20 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water. Get medical attention immediately. (Note: Do not use hot water.)

First Aid for Ingestion: Unlikely as product is a gas at normal temperatures. Get medical attention immediately. Treat symptomatically.

FIRE RESPONSE

Extinguishing Agents: Carbon dioxide, dry chemical or water fog or spray.

Extinguishing Techniques: Stay upwind. Avoid all bodily contacts. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Note that addition of water to any pools of liquid vinyl chloride may increase vapor evolution. Vinyl chloride may float on water. Do not use direct stream of water, product may be carried across water surface spreading fire or carrying product to source of ignition.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from contaminated runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of highly contaminated water may result in damage to boilers or industrial process equipment. Use explosion-proof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take into account that vinyl chloride is extremely volatile and flammable with heavier than air vapors that may persist in pits and depressions. Do not use monel, copper, or copper alloy equipment such as brass.

VINYL CHLORIDE

Division 2.1 (Flammable Gas)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Vinyl chloride may not evolve large amounts of hazardous airborne contaminants in certain outdoor spill situations. It may be advisable in some cases outside the isolation area to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed, particularly for small spills or in cold weather.

CONSEQUENCE

Hazardous levels of vinyl chloride in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vinyl chloride vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. NOTE: Water should be applied at a point downwind and should not be allowed to contact pools of liquid vinyl chloride as this may increase gas and vapor evolution.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain vinyl chloride from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

ALCOHOL FOAM . . . There is a possibility that alcohol foam applied to the surface of liquid pools may slow the release of vinyl chloride vapors into the atmosphere.

CONSEQUENCE

The effects of alcohol foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material. The response may be ineffective.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume. Use alternate technique if response is ineffective.

VINYL CHLORIDE

Division 2.1 (Flammable Gas)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Vinyl chloride may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained vinyl chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination. May generate large amounts of vapors which are highly flammable and can be easily ignited.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials. Make sure there are no sources of ignition near the area of the spill.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination. May generate large amounts of vapors which are highly flammable and can be easily ignited.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil. Make sure there are no sources of ignition near the area of the spill.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

VINYL CHLORIDE

Division 2.1 (Flammable Gas)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . **This technique should only be used under the guidance of a VC product specialist.** Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

January 1988

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

GENERAL INFORMATION

Vinylidene chloride is a clear, colorless, and highly volatile liquid that boils at 88.9°F and has a sweet odor like carbon tetrachloride or chloroform. It is primarily used to make plastic films for packaging and latexes used for mortars, concretes, adhesives, paints, fabrics, and lacquers. It is very slightly soluble in water and heavier, so may be expected to sink and dissolve at a very slow rate. Its flash point of 0-5°F indicates that it may be easily ignited under most ambient temperature conditions. Its relatively low boiling point and high vapor pressure indicate that it will boil at higher ambient temperatures or otherwise evaporate rapidly to produce large amounts of toxic and flammable vapors. These vapors are heavier than air, may travel a considerable distance to a source of ignition and flash back, and may persist for a time in pits, hollows, and depressions. Accumulations of vapor in confined spaces such as buildings or sewers may explode if ignited. Containers of liquid may rupture violently if exposed to fire or excessive heat for sufficient time duration (see below also). White solid deposits formed during prolonged storage may explode if heated or shocked. The liquid weighs approximately 10.1 pounds per gallon.

Vinylidene chloride does not react with water and is stable in normal transportation when inhibited to prevent self-polymerization. Polymerization may occur, however, if the product is exposed to sunlight, air, copper, or aluminum and their alloys, or excessive heat, and this also may result in violent rupture or explosions of containers. The product is relatively noncorrosive but is incompatible with oxidizing materials and various other substances. It is of moderate toxicity by the various potential routes of exposure and may be present in air in very high concentrations. Products of combustion may include highly toxic phosgene, chlorine, and hydrogen chloride gases.

Downwind evacuation should be considered if vinylidene chloride is leaking but not on fire. If a fire becomes uncontrollable or a container is exposed to direct flame, evacuate for a radius of one-half (½) mile for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Slightly soluble, 0.5 g/100 g water at 68°F (20°C)
Solubility in Other Chemicals: Soluble in acetone, alcohol, benzene, chloroform, and ether.
Specific Gravity (Liquid): 1.21 at 68°F (20°C)
Boiling Point: 88.9°F (31.6°C) at 1 atm.
Melting Point: See freezing point
Freezing Point: - 187.6°F (- 122°C)
Molecular Weight: 96.95
Heat of Combustion: - 2700 cal/g
Vapor Pressure: 400 mm Hg (7.732 psia) at 58.6°F (14.8°C)
Flash Point: 0 - 5°F (- 17.8 to - 15°C), open cup.
Autoignition Temperature: 955 - 1058°F (513 - 570°C)
Burning Rate: 2.7 mm/minute
Stability: Stable, but may polymerize under conditions described above.
Corrosiveness: Noncorrosive, but avoid copper or aluminum and their alloys.
Reactivity with Water: No reaction, but manufacturer says avoid water or moisture.
Reactivity with Other Chemicals: Reacts with air, sunlight, aluminum or copper and their alloys, oxidizing materials, ozone, chlorosulfonic acid, nitric acid, and oleum.

IDENTIFICATION

Shipping Names: Vinylidene chloride, inhibited (USDOT); vinylidene chloride (IMO)
Synonyms and Tradenames: 1,1-Dichloroethylene; 1,1-dichloroethene; vinylidene chloride monomer; unsym-dichloroethylene; Sconatex; VDC; 1,1-DCE; DCE.
Chemical Formula: $CH_2=CCl_2$
Constituent Components (% each): 99% pure with 200 ppm methyl ether of hydroquinone and 0.6 - 0.8%0 phenol as inhibitors.
49 STCC: 49 072 80
UN/NA Designation: UN1303
IMO Designation: 3.1, flammable liquid
Physical State as Shipped: Liquid
Physical State as Released: Liquid (boils at 88.9°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Sweet, pungent, like chloroform or carbon tetrachloride
Common Uses: Mfg. plastic films for food packaging; latexes used for mortars, concretes, paints, fabric fiber, adhesives, and lacquers; mfg. methyl chloroform.

FOR ADDITIONAL ASSISTANCE OR INFORMATION CALL:
CHEMTREC (800)424-9300 OR (703) 527-3887 (COLLECT)

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 500 ppm

Unusual Hazards: Highly volatile flammable liquid with heavier than air vapors that may travel to a source of ignition. May polymerize and cause violent container rupture or explosion (see General Information section). Toxic vapors may travel considerable distances and may persist in pits, hollows, and depressions. Vapors are uninhibited and may form polymers in vents and flame arrestors resulting in blockage.

Short Term Exposure Limits (STEL): 20 ppm for 15 minutes. (ACGIH)

Time Weighted Average (TLV-TWA): 5 ppm over each 8 hours of a 40 hour work week; 5 ppm proposed. (ACGIH)

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of the high vapor concentrations that may be present in air in the spill area and over considerable downwind distances. Direct contact and ingestion are also to be avoided. Exposure may possible sensitize the heart to epinephrin. Animal studies indicate possible carcinogenicity.

Hazards of Skin or Eye Contact: Liquid vinylidene chloride rapidly irritates the skin. Contact with the eyes may cause pain, conjunctiva) irritation, and transient corneal injury. High levels of phenolic inhibitor in inhibited product may possibly cause burns of the skin or eyes.

Hazards of Inhalation: Vapors of vinylidene chloride are irritating to the nose and respiratory system and may cause lung congestion. High concentrations in air are anesthetic and may result in dizziness, drowsiness, confusion, drunkenness, unconsciousness, and possibly death. Concentrations as low as 25 ppm cause some symptoms in humans.

Hazards of Ingestion: Although the single dose oral toxicity of vinylidene chloride is considered low, significant amounts may cause poisoning. Histological changes may be evident in the liver and lungs.

FIRE HAZARDS

Lower Flammable Limit: 5.6-7.3%

Upper Flammable Limit: 15.5-16.0%

Behavior in Fire: Flammable liquid. Will generate large quantities of flammable vapor upon release. Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may rupture violently in fire. Exposure of containers to fire may result in violent polymerization and container rupture.

Hazardous Combustion Products: May include highly toxic phosgene, chlorine, and hydrogen chloride gases.

EXPLOSION HAZARDS

Lower Explosive Limit: Unavailable

Upper Explosive Limit: Unavailable

Explosiveness: Explosion may result if vapors are ignited in a confined area. Containers may rupture violently in fire. Loss of inhibitor or excessive heat or light may cause spontaneous polymerization resulting in violent container rupture. Polymerization may also occur in the presence of aluminum or copper or their alloys or air. White deposit formed on long standing may explode if heated or shocked.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should prevent any reasonable probability of skin contact and any possibility of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations, a self-contained breathing apparatus (SCBA) with full facepiece (or the equivalent). For lesser concentrations, a gas mask with an appropriate chin-style or front or back mounted canister or an appropriate chemical cartridge respirator with a full facepiece within the use limitations of these devices.

1303

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

FIRST AID

Nonspecific symptoms: Irritation of the eyes, skin, nose, or respiratory tract; other symptoms of exposure.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. If breathing becomes difficult or if breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: Administration of mouth-to-mouth resuscitation may expose the first aid provider to chemical within the victim's lungs or vomit.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Remove all contaminated clothing. Wash affected body areas with large amounts of water. Get medical attention if eye contact has occurred or if skin irritation persists after washing.

First Aid for Ingestion: If victim is conscious, administer two glasses *of* water immediately and induce vomiting. Do not make an unconscious person vomit. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Carbon dioxide, dry chemical, foam, water spray. Water may be ineffective but may possibly be used to blanket contained liquid pools.

Extinguishing Techniques: Stay upwind. Avoid all bodily contacts. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish burning cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat (over 800°F), such as from a direct flame. Use water from side and from safe distance to keep fire exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank.

SPILL RESPONSES

General Information: Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Eliminate ignition sources. Prevent liquid from entering sewers and confined spaces. Protect sewers and waterways from runoff. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of vinylidene chloride may result in rupture or explosion of boilers or industrial process equipment. Use explosionproof equipment where necessary. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Take the highly volatile, reactive, flammable, and toxic nature of vinylidene chloride into account while planning the response. Do not use copper or aluminum or their alloys (including brass). Beware of possible heavy gas accumulations in low areas.

AIR SPILL

TECHNIQUE

EVACUATION . . . Evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. Vinylidene chloride spills may expose downwind areas to toxic or flammable concentrations over considerable distances in some cases.

CONSEQUENCE

Need to notify, organize, transport and house displaced persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to vinylidene chloride vapors or fumes may accelerate their dispersal in the atmosphere.

CONSEQUENCE

Water runoff may contain a small amount (if any) of vinylidene chloride from contact with airborne vapors or fumes.

MITIGATION

Contain contaminated water and remove as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of vinylidene chloride vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

TECHNIQUE

WATER APPLICATION. . . Application of water to the surface of liquid pools may reduce emissions of vapors or fumes. Water should float on top of contained product.

CONSEQUENCE

Addition of water will increase the volume of contained material.

MITIGATION

Contain increased volume and remove as soon as possible. Be alert to conditions that may add to volume and overfill impoundments.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Vinylidene chloride may be contained by building dikes or barriers using soil, sand or other materials.

CONSEQUENCE

Contained vinylidene chloride may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Removed contained product as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection basins with compatible impervious material.

TECHNIQUE

EXCAVATION . . . A trench or ditch may be excavated to contain leaking product.

CONSEQUENCE

There may be increased potential for groundwater contamination in some cases.

MITIGATION

Remove contained products as soon as possible to prevent spread of contamination. Use surface dikes or barriers where groundwater contamination is possible or line collection basin with compatible impervious material.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Accumulated liquid pools may be recovered using appropriate hoses, pumps and storage containers or vacuum trucks.

CONSEQUENCE

Equipment that is incompatible with the spilled product may become damaged or develop leaks.

MITIGATION

Use equipment compatible with spilled product,

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means.

TECHNIQUE

MECHANICAL REMOVAL. . . Contaminated soil and any remaining chemical residue may be removed with shovels or motorized graders, scrapers, loaders, bulldozers, or draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in a safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres. Consult qualified experts for advice where necessary.

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal, and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may be needed to accommodate users.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

CONTAINMENT . . . Spilled product will sink in water. Use natural deep water pockets, excavated lagoons, or sand bag barriers to trap material on bottom and limit spread of contamination.

CONSEQUENCE

Excavation of deep water pocket or lagoon downstream of spill area may be difficult and may have adverse environmental impacts.

MITIGATION

Excavate as last resort.

TECHNIQUE

DREDGING/PUMPING . . . Stream or lake beds may be dredged to remove heavier-than-water spilled products and contaminated bottom sediments. Contaminated materials may be deposited in a barge or pumped ashore. Alternatively, where pools or spilled product have accumulated, hoses and pumps or vacuum trucks may be used for product recovery.

CONSEQUENCE

Dredging may accelerate dispersal of spilled product through the water body and cause other environmental damage. Incompatible equipment may be damaged. Dredged or pumped materials brought to the surface may emit toxic or flammable vapors.

MITIGATION

Consult qualified experts for guidance.

VINYLIDENE CHLORIDE
CLASS 3 (Flammable Liquid)

TECHNIQUE

CONTAINMENT DIKES . . . Water with dissolved chemical may be contained (or diverted to impoundment area) by diking upper and/or lower bounds to limit volume of water affected and spread of contamination.

CONSEQUENCE

Earthen dikes may become saturated with water and seep through or collapse. Additional water may cause overflow of diked area or water body boundaries.

MITIGATION

Reinforce or modify dikes as necessary. Be alert to conditions that may lead to overflow or dike collapse. Remove contaminated water to impoundment or storage area for later treatment or disposal.

TECHNIQUE

ADSORPTION . . . Addition of activated carbon to the contaminated water, followed by effective mixing, may capture spilled product that has dissolved in water. Adsorbent materials may later be removed by mechanical means.

CONSEQUENCE

Recovery of activated carbon may require dredging in a process that poses risk of environmental damage. Recovered adsorbent materials will be contaminated with spilled product, as may recovery equipment.

MITIGATION

Consult qualified experts for safe adsorption techniques. Consider pumping water through tank containing adsorbent on land. Handle and store recovered materials safely. Decontaminate equipment as necessary.

TECHNIQUE

AERATION . . . Water containing dissolved volatile chemicals may be decontaminated to some degree by aeration, air stripping, or air sparging techniques. These involve the use of air compressors and perforated piping to bubble large quantities of air through the contaminated water body.

CONSEQUENCE

The air bubbles entering the atmosphere will be contaminated with some amount of chemical vapors if the technique is effective.

MITIGATION

Consult qualified experts for advice and assistance in obtaining and deploying necessary equipment. Apply alternative techniques where air emissions may pose a downwind hazard.

September 2006

XYLENE

Class 3 (Flammable Liquid)

GENERAL INFORMATION

Commercially available xylene is typically a mixture of three isomeric forms called ortho-, meta-, and para-xylene, with the meta- isomer usually being predominant. All are colorless aromatic hydrocarbon liquids with an odor resembling benzene or gasoline. The mixture is widely used as a solvent and for making pharmaceuticals, epoxy resins, perfumes, insect repellents, dyes and a variety of other chemicals and products. It is almost completely insoluble in water and lighter, therefore, it may be expected to form a floating surface slick. Flash points ranging from 63 – 84°F for the various isomers indicate that the mixture can be easily ignited at warm ambient temperatures. Vapors may be heavier than air and may travel some distance to a source of ignition and flash back. Accumulations of vapor in buildings or sewers may explode if ignited. There is some limited potential for containers to rupture violently if exposed to fire or excessive heat for sufficient time duration. The isomers weigh approximately 7.2 – 7.3 pounds per gallon.

Xylenes do not react with water or many other common materials and are stable in normal transportation. They are primarily incompatible with strong oxidizers and acids that may cause their ignition. Although they are noncorrosive to most metals, they may attack some forms of plastics, rubber and coatings. Toxicity is generally low to moderate via the various routes of exposure. Products of combustion may include toxic constituents.

If xylene is involved in an incident, as an immediate precautionary measure, isolate spill or leak area for at least 150 feet (50 meters) in all directions. If the spill is large, consider initial downwind evacuation of 1000 feet (300 meters). If a bulk container is exposed to direct flame or a fire becomes uncontrollable, evacuate for one-half (1/2) mile (800 meters) in all directions for protection from flying debris if the container should rupture violently.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Insoluble, 0.02% at 68°F (20°C)
Solubility in Other Chemicals: Soluble in carbon tetrachloride, alcohol, ether, petroleum ether, acetone, benzene and organic solvents.
Specific Gravity (Liquid): 0.861 – 0.880 at 68°F (20°C)
Vapor Density: 3.7
Boiling Point: 277 – 293°F (136 – 145°C)
Melting Point: 55.9°F (13.3°C) for p-xylene
Freezing Point: –54.2°F (–47.9°C) for meta-; –13.3°F (–25.2°C) for ortho-
Molecular Weight: 106.16
Heat of Combustion: –9752 to –9755 cal/g
Evaporation Rate (butyl acetate=1): 0.6 – 0.86
Vapor Pressure: 7 – 9 mmHg (0.135 – 0.174 psia) at 68°F (20°C)
Flash Point: 63 – 84°F (17.2 – 28.9°C) closed cup
Autoignition Temperature: 810 – 986°F (432 – 530°C)
Burning Rate: 5.8 mm/minute
Flammable (Explosive) Limits: 0.9 – 1.1% (LEL) – 6.7 – 7.0% (UEL)
Stability: Stable
Polymerization Potential: Will not occur
pH: Not applicable
Corrosiveness: Noncorrosive to most metals; may attack some plastics, rubber and coatings.
Reactivity with Water: No reaction
Reactivity with Other Chemicals: Reacts with strong oxidizers and acids.

IDENTIFICATION

Shipping Names: Xylenes (USDOT & IMO)
Synonyms and Tradenames: Xylol; o-Xylene; ortho-Xylene; 1,2-Dimethylbenzene; m-Xylene; meta-Xylene; 1,3-Dimethylbenzene; p-Xylene; para-Xylene; 1,4-Dimethylbenzene; Methyltoluene; Violet 3.
CAS Registry No.: 1330-20-7 (mixed); 108-38-3 (m-Xylene); 95-47-6 (o-Xylene); 106-42-3 (p-Xylene)
Chemical Formula: $C_6H_4(CH_3)_2$
Constituent Components (% each): Commercial mixtures contain small amounts ethylbenzene, toluene, trimethylbenzene, phenol, thiophene, pyridine and other nonaromatic hydrocarbons.
UN/NA Designation: UN1307
IMO Designation: 3, flammable liquid
RTECS Number: ZE2100000 (mixed); ZE2275000 (m-Xylene); ZE2450000 (o-Xylene); ZE2625000 (p-Xylene)
NFPA 704 Hazard Rating: 2 (Health): 3 (Flammability): 0 (Instability)
Physical State as Shipped: Liquid
Physical State as Released: Liquid (pure para- freezes at 55.9°F)
Color of the Shipped Material: Colorless
Odor Characteristics: Aromatic, characteristic, sweet, like benzene or gasoline.
Reportable Quantity: See Appendix I
Common Uses: Solvent in paints, lacquers, varnishes, inks, dyes, adhesives, cements, cleaning fluids; fuel component; mfg. dyes, insecticides, resins and fibers, pharmaceuticals, quartz crystal oscillators, perfumes, insect repelents, leather, and numerous other chemicals or binder; fiber sizing.

ADDITIONAL INFORMATION AND ASSISTANCE: FOR 24-HOUR TECHNICAL SUPPORT FOR ACCIDENTS INVOLVING SPILLS, LEAKS, FIRES OR EXPOSURES TO CHEMICALS, CONTACT CHEMTREC AT (800) 424-9300 OR (703) 527-3887 (COLLECT).

XYLENE

Class 3 (Flammable Liquid)

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0.2 – 4 ppm

Unusual Hazards: Volatile flammable liquid with heavier than air vapors that may travel to a source of ignition and flash back. Vapors may persist for a time in pits, hollows and depressions. There is the potential that flowing product may be ignited by self-generated static electricity. May be toxic to aquatic organisms.

Short Term Exposure Limits (STEL): 150 ppm (655 mg/m^3) (NIOSH)

Time Weighted Average (TLV-TWA): 100 ppm (435 mg/m^3) (NIOSH & OSHA)

Ceiling (C) Limit: Unavailable

IDLH: 900 ppm

Conditions to Avoid: Heat, fire, or sparks; contact with incompatible materials; runoff to sewers or water bodies; inhalation, ingestion, or direct physical contact.

HEALTH HAZARDS

Public Health Hazards: Major hazard is from inhalation of high vapor concentrations in air near the spill site. Ingestion and physical contact should also be avoided.

Hazards of Skin or Eye Contact: Repeated or prolonged contact with liquid xylenes may cause drying, cracking, and inflammation of the skin due to the defatting action of the product. Some amount may be absorbed through the skin and blisters may occur. Contact of the liquid or high vapor concentrations in air with the eyes may cause irritation, burning, redness, swelling and temporary corneal injury.

Hazards of Inhalation: Vapors of xylenes are irritating to the eyes, nose, and throat. High concentrations may cause narcosis and central nervous system depression with symptoms including dizziness, staggering, drowsiness, shortness of breath, coughing, nausea, vomiting, abdominal pain, temporary damage to kidneys and liver, delayed pulmonary edema, loss of appetite, unconsciousness and possibly death.

Hazards of Ingestion: Ingestion of xylenes may result in nausea, vomiting, cramps, headache, kidney and liver injury, coma, and possibly death. Aspiration into the lungs during vomiting may cause coughing, respiratory distress, rapidly developing pulmonary edema, chemical pneumonitis, and hemorrhage with possibly severe consequences.

FIRE HAZARDS

Lower Flammable (Explosive) Limit: 0.9 – 1.1%

Upper Flammable (Explosive) Limit: 6.7 – 7.0 %

Behavior in Fire: Flammable liquid. There is some limited potential that containers may rupture violently in fire. May generate flammable vapors upon release. Vapors may be heavier than air and may travel to a source of ignition and flash back.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide and other organic compounds.

EXPLOSION HAZARDS

Explosiveness: There is some limited potential that containers may rupture violently in fire. Explosion may result if vapors are ignited in a confined area.

PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

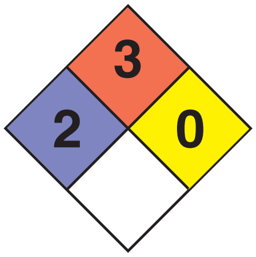
Protective Clothing Required: Equipment should prevent repeated or prolonged skin contact and any reasonable probability of eye contact with the spilled product. This may include rubber boots, gloves, face shields, splash-proof safety goggles, and other impervious and resistant clothing. The following materials are reported to have a greater than 8 hour breakthrough time: Tychem® CPF 4; Tychem® BR; Tychem® LV; Tychem® TK; Viton 890® gloves; and Viton 892® gloves. The following materials are reported to have a greater than 4 hour breakthrough time: Tychem® ThermoPro. The following materials are ***not*** recommended for use: neoprene, latex or rubber, butyl and nitrile latex.

Respiratory Protection: For unknown concentrations, fire fighting, or high concentrations (above 900 ppm): any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. For lesser concentrations (below 900 ppm): any air-purifying half-mask respirator* equipped with organic vapor cartridge(s); any powered air-purifying respirator* with organic vapor cartridge(s); any supplied-air respirator*; or any self-contained breathing apparatus with a full facepiece. Note: Respirators noted with (*) may require eye protection.

1307

XYLENE

Class 3 (Flammable Liquid)



FIRST AID

Nonspecific Symptoms: Irritation of the eyes, skin, nose, or respiratory tract; symptoms of narcosis.

First Aid for Inhalation: Remove victim to fresh air and keep warm and at rest. Administer oxygen if breathing is difficult. If breathing has stopped, administer artificial respiration. Avoid mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately.

First Aid for Skin Contact: Remove all contaminated clothing. Wash affected body areas with large amounts of soap and water for at least 20 minutes. Get medical attention immediately if irritation persists after washing. Decontaminate the patient thoroughly before transporting to a medical treatment facility to prevent the potential for secondary contamination.

First Aid for Eye Contact: Flush eyes immediately with water for at least 15 minutes, occasionally lifting the eyelids. Get medical attention immediately if irritation persists after rinsing.

First Aid for Ingestion: Do not attempt to make the victim vomit, rinse mouth thoroughly with water, administer large quantities of water. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Agents: Foam, dry chemical, carbon dioxide, water spray or fog. Water may be ineffective.

Extinguishing Techniques: Stay upwind. Avoid all bodily contact. Wear breathing apparatus and appropriate protective clothing. Move container from fire area if no risk. Do not extinguish cargo unless flow can be stopped safely. Be alert to the possibility that the container may tear or rupture and suddenly release massive amounts of product when exposed to high heat, such as from a direct flame. Stay away from ends of tank involved in fire but realize that shrapnel may travel in any direction. Use water from side and from safe distance to keep fire-exposed containers cool. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Withdraw immediately in case of rising sound from venting safety device or discoloration of tank. Xylene may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. Dike fire control water for proper disposal since it may contain flammable vapors. Note that xylene has a flash point as low as 63°F.

SPILL RESPONSES

General Information: Xylene is a highly flammable and volatile liquid that may cause environmental contamination even though it is expected to biodegrade to a moderate extent when released into the soil or water. Proceed with caution. Restrict access to area. Keep unprotected personnel upwind of spill area. Avoid contact with spilled product. Personnel must wear the appropriate level of personal protective clothing and equipment for spill response operations. Eliminate ignition sources. Prevent liquid from entering sewers, waterways and confined spaces. Notify proper authorities, downstream sewer and water treatment operations, and other downstream users of potentially contaminated water. Note that intake of xylene may result in rupture or explosion of boilers or industrial process equipment. All containers should be checked for product compatibility and properly bonded and grounded during product transfer operations to eliminate the potential for ignition. Use explosion-proof equipment where necessary. Compatibility of vacuum trucks and equipment must be determined prior to commencing clean-up operations. Choose equipment, where possible, that is not corroded or otherwise damaged by the spilled product. Establish a decontamination area remote from the contaminated zone. Ensure that all protective clothing and equipment is isolated for disposal or cleaning. Ensure proper decontamination of emergency personnel before they leave the scene. Personnel should monitor for the presence of hazardous vapors before removing respiratory protection equipment. Dispose of contaminated material as soon as possible in accordance with applicable local, state and federal environmental regulations. Consult environmental specialists for assistance, as needed. Take into account while planning the response that xylene is a highly flammable substance that may float on water. Beware of possible heavy vapor accumulations in pits, hollows or depressions.

XYLENE

Class 3 (Flammable Liquid)

AIR RELEASE

TECHNIQUE

IMPLEMENT PUBLIC PROTECTIVE ACTIONS . . . Where possible, evacuate local and downwind areas as conditions warrant to prevent exposure and to allow vapors or fumes to dissipate. If evacuation is not possible, or may increase risk to the population, shelter in place. The decision to evacuate or to shelter will be affected by many factors, some of which may be degree of health hazard, amount of spilled material, movement of vapors, weather conditions or number of people affected. For shelter in place, direct the people inside to close all doors and windows, shut off all HVAC (Heating, Venting and Air conditioning) systems, and turn on local AM and FM radio stations for emergency broadcast. Evacuation guidelines can be found under the General Information section on page 1.

CONSEQUENCE

Need to notify, organize, transport, house and communicate with displaced/affected persons.

MITIGATION

Stop leak if without risk and if proper equipment available. Allow vapors and fumes to dissipate completely before reentering spill area without special protective gear. Consult qualified experts for assistance.

TECHNIQUE

MONITOR THE SITUATION . . . Xylene may not evolve large amounts of hazardous airborne contaminants in many outdoor spill situations. It may be advisable in some cases to simply monitor the spill using a combustible gas indicator to check for flammable vapors until the spilled product is removed.

CONSEQUENCE

Hazardous levels of xylene in air may be found in the local spill area and immediately downwind.

MITIGATION

Remove the spilled product as soon as possible. Restrict access to the local spill area and areas immediately downwind by unprotected personnel.

TECHNIQUE

WATER FOG OR SPRAY . . . Water fog or spray applied to xylene vapors or fumes may absorb vapors, knock down fumes and accelerate their dispersal in the atmosphere. Xylene may float on water. Do not use direct stream of water. Product may be carried across water surface spreading fire or carrying product to source of ignition. NOTE: Water should be applied at a point downwind of the spill.

CONSEQUENCE

Increases in spill surface area and atmospheric conditions may increase the rate of vapor generation. In enclosed areas, runoff may add to spill volume and overfill impoundments. Water runoff may contain xylene from contact with its vapors or fumes.

MITIGATION

Contain contaminated water and remove or neutralize as soon as possible to prevent spread of contamination. Be alert to conditions such as fire hose runoff or rainwater that may add to spill volume and overfill impoundments. Consult qualified experts for safe neutralizing techniques.

TECHNIQUE

FOAM . . . Firefighting foam applied to the surface of liquid pools may slow the release of xylene vapors into the atmosphere.

CONSEQUENCE

The effects of foam may be short term. As the foam breaks down, release of vapors will increase. Products of foam breakdown will add to the volume of spilled material.

MITIGATION

Continue foam applications until spilled product is removed. Contain increased volume.

XYLENE

Class 3 (Flammable Liquid)

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES . . . Xylene may be contained by building dikes using soil, dry sand or other non-combustible materials.

CONSEQUENCE

Contained xylene may percolate into soil or seep through dike material. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove or neutralize contained product as soon as possible to prevent spread of contamination. The integrity of dikes should be monitored periodically since they may fail over time. Be alert to conditions such as fire hose runoff or rainwater that may overfill impoundments. Where possible, line collection area with compatible impervious materials.

TECHNIQUE

EXCAVATION . . . Spills of material may be confined by building trenches or ditches.

CONSEQUENCE

Material may leach into soil. Deep excavations may increase the potential for groundwater contamination in some areas. This may result in loss of contained product and spread of contamination.

MITIGATION

Remove material from contaminated area as quickly as possible to prevent possible contamination beyond the spill area. Be alert to conditions such as increasing spill volume with runoff or rainwater which may overfill diked areas. If possible, containment areas should be lined with suitable, impervious material to prevent penetration into soil.

TECHNIQUE

PUMPING/VACUUM SUCTION . . . Spilled material contained in diked areas may be recovered using compatible hoses, pumps and vacuum trucks. All product transfer equipment should be properly bonded and grounded.

CONSEQUENCE

Equipment that is not compatible with the spilled product may become damaged and present a safety hazard for response personnel. Mechanical equipment will become contaminated with removed product.

MITIGATION

Use equipment constructed of materials compatible with the spilled product. Decontaminate equipment.

TECHNIQUE

ABSORPTION . . . Spreading of spilled product may be controlled by absorbing liquid with sand, earth, clay, fly ash, cement powder, peat moss, saw dust, straw, commercial sorbents, or other compatible substances.

CONSEQUENCE

Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material.

MITIGATION

Deplete accumulated liquid pools with pumps or vacuum trucks if possible before applying sorbents. Remove contaminated sorbents to safe storage by mechanical means. Where necessary, neutralize sorbents under guidance of qualified expert.

TECHNIQUE

MECHANICAL REMOVAL . . . Contaminated soil and spilled product may be removed by shovels, motorized graders and scrapers, loaders, bulldozers and draglines.

CONSEQUENCE

Removal equipment may become contaminated and present a hazard to later users. Incompatible equipment may be damaged or corroded. Improper storage of removed materials may result in future spread of contamination. Any flammable vapors or gases present in the area may be ignited by motorized removal equipment.

MITIGATION

Decontaminate all equipment after use. Use equipment compatible with spilled product. Store contaminated materials in safe and secure location. Do not operate motorized equipment in potentially flammable atmospheres.

XYLENE

Class 3 (Flammable Liquid)

WATER SPILL

TECHNIQUE

STOP USE . . . Notify downstream industrial, municipal and public users to stop water intake or to monitor water for contamination.

CONSEQUENCE

Alternative water supplies may need to be established. Consult environmental specialists for assistance, as needed.

MITIGATION

Provide alternative water supplies as needed until water supply is declared safe.

TECHNIQUE

FLOATING BOOMS/BARRIERS . . . Oil spill containment booms of compatible material may be deployed. Alternatively, mesh or nets may be strung across stream and anchored every 6–8 feet. Straw or peat placed on upstream side of mesh should absorb and retard spreading of spilled product.

CONSEQUENCE

Leakage may occur under or through barrier if high waves or current present or if not properly deployed. Incompatible materials may be damaged by spilled product. Booms, barrier materials, and deployment equipment may be contaminated. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Stage barriers in series where necessary. Recover spilled product as soon as possible. Decontaminate equipment after use. Dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

TECHNIQUE

UNDER-FLOW DAMS . . . Streams may be provided with a by-pass dam. This is a dam made of compacted earth, clay, or other material with open tubes or pipes passing through under water. Upstream ends of pipes or tubes should be well below the layer of floating contaminant. Downstream ends should be at a higher elevation but still below the floating layer. Valves may be installed on downstream ends to control water flow.

CONSEQUENCE

Earthen dams may become saturated with water and seep through or collapse. An insufficient number of by-pass tubes or pipes or additional water may cause overflow.

MITIGATION

Use sufficient number and capacity of tubes or pipes. Be alert to conditions that may lead to dam overflow or collapse. Remove spilled product as soon as possible.

TECHNIQUE

DIVERSION . . . Where other means are unavailable, floating slicks may be temporarily herded, diverted, or controlled using water hose streams, small boat propeller wash or chemical surface tension modifiers known as spill herders.

CONSEQUENCE

Hose streams and propeller washes have limited applicability and effectiveness. The latter may cause undesired mixing of spilled product and water due to extreme agitation. Chemical spill herders should not be used until approval is obtained from authorized environmental officials.

MITIGATION

Use other means if available.

TECHNIQUE

SURFACE SKIMMING . . . Oil spill skimming devices may be deployed to recover floating xylene.

CONSEQUENCE

Incompatible equipment may be damaged. Equipment may be contaminated and pose hazard to future users. Fire hazard may pose risk to response personnel and equipment.

MITIGATION

Decontaminate equipment after use. Use compatible equipment. Store recovered product in safe and secure location. Eliminate ignition sources.

TECHNIQUE

ABSORPTION . . . Straw, hay, peat, or commercial sorbent materials compatible with xylene may be used to absorb spilled product from the water surface, preferably after the spill has been contained.

CONSEQUENCE

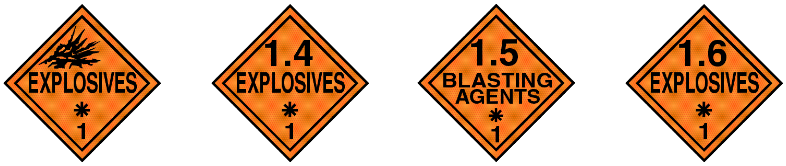
Once used, sorbent materials pose the same hazards as the spilled product. Their use adds to the overall volume of contaminated material. Deployment and recovery can be difficult. Fire hazards pose risk to response personnel and equipment.

MITIGATION

Proceed with caution. Decontaminate equipment after use. Store and dispose of waste materials in proper and safe manner. Use compatible equipment. Eliminate ignition sources.

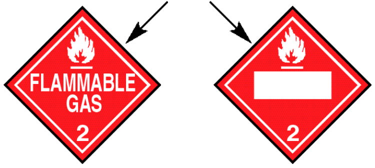
APPENDIX A
U.S. D.O.T. PLACARDS

If permitted, the alternate display incorporating the UN/NA 4-digit number on the orange panel appears to the right of the placard

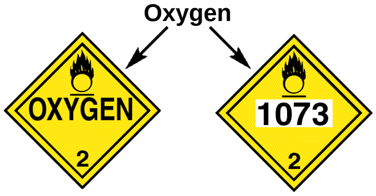


✱Replace with Division and Compatibility Code (i.e., 1.1A)

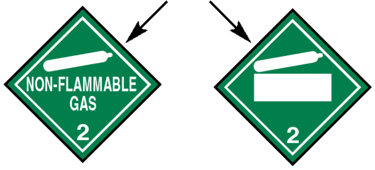
Division 2.1
(Flammable Gas)



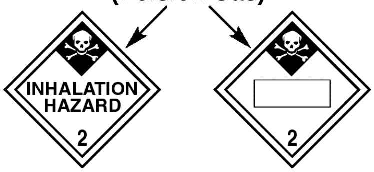
Oxygen



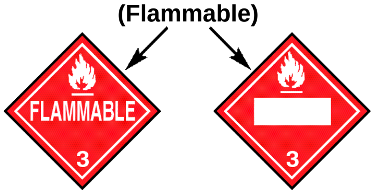
Division 2.2
(Non-Flammable Gas)



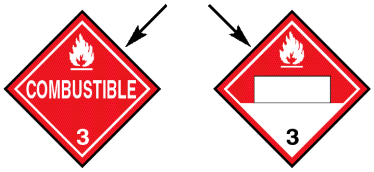
Division 2.3
(Poision Gas)



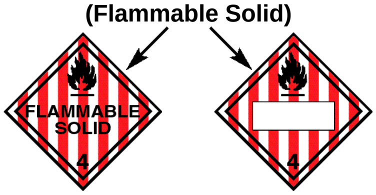
Class 3
(Flammable)



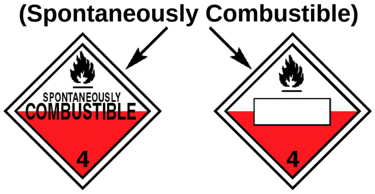
Combustible



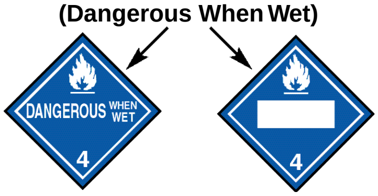
Division 4.1
(Flammable Solid)



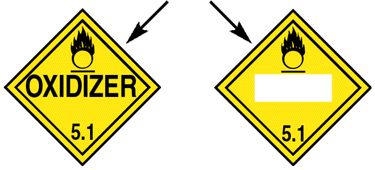
Division 4.2
(Spontaneously Combustible)



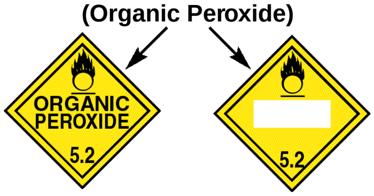
Division 4.3
(Dangerous When Wet)



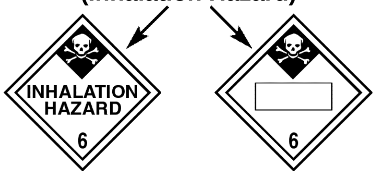
Division 5.1
(Oxidizer)



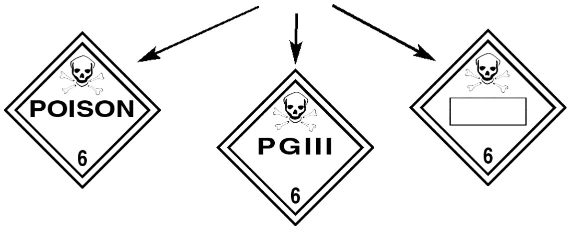
Division 5.2
(Organic Peroxide)



Class 6
(Inhalation Hazard)

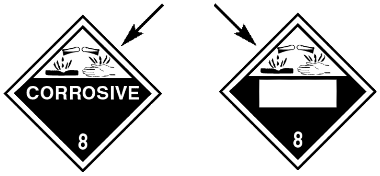


Class 6
(Poison)

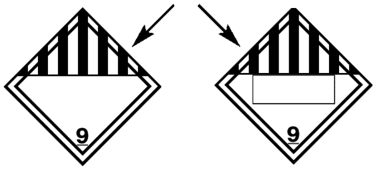


Class 7
(Radioactive)

Class 8
(Corrosive)

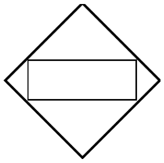


Class 9



Mixed Loads

Square-on point configuration



NOTE: No alternate display is permitted for EXPLOSIVES, RADIOACTIVE or DANGEROUS materials.

Orange Panel

When required on tank cars,portable tanks or cargo tanks,identification numbers,as specified in §172.101,shall be displayed on an orange panel or placard.§172.332.An identification number may not be displayed on a Dangerous,Radioactive or Explosives placard.172.334(a); but if a tank car, portable tank or cargo tank carrying such a commodity requires an identification number, it must be displayed on an orange panel.§172.332.

APPENDIX B
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA Fire Diamonds)
(NFPA No. 49-1994)

Degrees of Health Hazard Color Code: BLUE		Degrees of Flammability Hazard Color Code: RED		Degree of Reactivity (Instability) Hazard Color Code: YELLOW	
Severity of the Effects of Exposure		Susceptibility of Materials to Burning		Quantity of Energy Release	
Degree		Degree		Degree	
4	Materials that, on very short exposure, could cause death or major residual injury, including those that are too dangerous to be approached without specialized protective equipment	4	Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily.	4	Materials that in themselves are readily capable of reaction at normal temperatures and pressures. This degree usually includes materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures
3	Materials that, on short exposure, could cause serious temporary or residual injury, including those requiring protection from all bodily contact.	3	Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, through unaffected by ambient temperatures, are readily ignited under almost all conditions.	3	Materials that in themselves are capable of detonation or explosive decompositions or explosive reaction, but that require a strong initiating source or that must be heated under normal confinement before initiation.
2	Materials that, on intense or short exposure, could cause temporary incapacitation or possible residual injury, including those requiring the use of respiratory protective equipment that has an independent air supply.	2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperature or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air.	2	Materials that readily undergo violent chemical change at elevated temperatures and pressures.
1	Materials that, on short exposure, could cause irritation, but only minor residual injury, including those requiring the use of an approved air-purifying respiratory.	1	Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur.	1	Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures.
0	Materials that on short exposure under fire conditions, would no other hazard beyond that or ordinary of ordinary combustible materials	0	Materials that will not burn. This degree usually includes any material that will not burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 minutes	0	Materials that in themselves are normally stable, even under fire conditions

Excerpted from NFPA 49, Hazardous Chemicals Data 1994 Edition with permission from NFPA in 1980. For complete information on the types of materials usually included within each degree please refer to NFPA 49.

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APPENDIX C

INTERNATIONAL MARITIME ORGANIZATION (IMO) International Maritime Dangerous Goods (IMDG) Code

CLASS DEFINITIONS

CLASS 1—EXPLOSIVES

Class 1 comprises:

(a) Explosive substances (a substance which is not itself an explosive but which can form an explosive atmosphere of gas, vapor or dust is not included in class 1), except those which are too dangerous to transport or those where the predominant hazard is one appropriate to another class;

(b) Explosive articles, except devices containing explosive substances in such quantity or of such a character that their inadvertent or accidental ignition or initiation during transport should not cause any effect external to the device either by projection, fire, smoke, heat or loud noise; and

(c) Substances and articles not mentioned under (a) and (b) which are manufactured with a view to producing a practical, explosive or pyrotechnic effect.

Class 1 is Divided into five divisions:

Division 1.1 Substances and articles which have a mass explosion hazard

Division 1.2 Substances and articles which have a projection hazard but not a mass explosion hazard

Division 1.3 Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard

This division comprises substances and articles:

(a) which give rise to considerable radiant heat; or

(b) which burn one after another, producing minor blast or projection effects or both.

Division 1.4 Substances and articles which present no significant hazard

This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

Note: Substances and articles in this division are in compatibility group S if they are so packaged or designed that any hazardous effects arising from the accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder fire fighting or other emergency response efforts in the immediate vicinity of the package.

Division 1.5 Very insensitive substances which have a mass explosion hazard

This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

Division 1.6 Extremely insensitive articles which do not have a mass explosion hazard

This division comprises articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Note: The risk from articles of division 1.6 is limited to the explosion of a single article.

CLASS 2—GASES

A gas is a substance which:

(a) at 112°F (50°C) has a vapor pressure greater than 300 kPa; or

(b) is completely gaseous at 68°F (20°C) at a standard pressure of 101.3 kPa.

The transport condition of gas is described according to its physical state as:

(a) Compressed gas - a gas (other than in solution) which, when packaged under pressure for transport, is entirely gaseous at 20°C;

(b) Liquefied gas - a gas which, when packaged for transport, is partially liquid at 20°C;

(c) Refrigerated liquefied gas - a gas which, when packaged for transport, is made partially liquid because of its low temperature; or

(d) Gas in solution - compressed gas which, when packaged for transport, is dissolved in a solvent.

Note: In cases (a), (b) and (d) above, the gases are normally under pressure.

Class 2 is subdivided further, namely:

Class 2.1—Flammable gases
Class 2.2—Non-flammable, non-toxic gases
Class 2.3—Toxic gases

CLASS 3—FLAMMABLE LIQUIDS

Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (such as paints, varnishes, lacquers, etc., but not including substances which, on account of their other dangerous characteristics, have been included in other classes) which give off a flammable vapor at or below 141.8°F (61°C) closed cup test (corresponding to 150°F (65.6°C) open cup test), normally referred to as the flashpoint. This also includes:

(a) Liquids offered for transport at temperatures at or above their flashpoint; and

(b) Substances transported or offered for transport at elevated temperatures in a liquid state, which give off a flammable vapor at temperatures equal to or below the maximum transport temperature.

CLASS 4—FLAMMABLE SOLIDS; SUBSTANCES LIABLE TO SPONTANEOUS COMBUSTION; SUBSTANCES WHICH, IN CONTACT WITH WATER, EMIT FLAMMABLE GASES

Class 4 deals with substances, other than those classified as explosives, which, under conditions of transport, are readily combustible or may cause or contribute to a fire. Class 4 is subdivided as follows:

Class 4.1 Flammable solids. Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances (solids and liquids) which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently;

Class 4.2 Substances liable to spontaneous combustion. Substances (solids and liquids) which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire;

Class 4.3 Substances which, in contact with water, emit flammable gases. Substances (solids and liquids) which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

CLASS 5 - OXIDIZING SUBSTANCES AND ORGANIC PEROXIDES

Class 5 is divided into two classes as follows:

Class 5.1 Oxidizing substances. Substances which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material. Such substances may be contained in an article;

Class 5.2 Organic peroxides. Organic substances which contain the bivalent -O-O- structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable substances which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties:
- be liable to explosive decomposition;
- burn rapidly;
- be sensitive to impact or friction;
- react dangerously with other substances;
- cause damage to the eyes.

CLASS 6 - TOXIC AND INFECTIOUS SUBSTANCES

Class 6 is subdivided into two classes as follows:

Class 6.1 Toxic substances. These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact.

Class 6.2 Infectious substances. These are substances known or reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (including bacteria, viruses, rickettsiae, parasites, fungi) or recombinant micro-organisms (hybrid or mutant), that are known or reasonably expected to cause infectious disease in animals or humans.

CLASS 7 - RADIOACTIVE MATERIAL

Radioactive material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the IMDG Code.

CLASS 8 – CORROSIVE SUBSTANCES

Class 8 substances (corrosive substances) means substances which, by chemical action, will cause severe damage when in contact with living tissue or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport.

CLASS 9 - MISCELLANEOUS DANGEROUS SUBSTANCES AND ARTICLES

Class 9 substances and articles (miscellaneous dangerous substances and articles) comprise:

(a) Substances and articles not covered by other classes which experience has shown, or may show, to be of such a dangerous character that the provisions of the Code should apply; these include substances that are transported or offered for transport at temperatures equal to or exceeding 212°F (100°C) in a liquid state, and solids that are transported or offered for transport at temperatures equal to or exceeding 464°F (240°C); and

(b) Substances which are considered marine pollutants.

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APPENDIX D

GLOSSARY

ACGIH: American Conference of Governmental Industrial Hygienists, 6500 Glenway Ave., Bldg. D-5, Cincinnati, OH 45211 (513-661-7881)

Acidic: Acid forming; having a pH below 7.

Acidosis: An abnormal state of reduced alkalinity of the blood and body tissues.

Active metals: This refers to metals such as aluminum, calcium, magnesium, potassium, sodium, tin, zinc, and their alloys.

Acute exposures: An acute exposure to a chemical is one that takes place over a short period of time and that is unlikely to be repeated in the immediate future.

Alkali: Any substance, which in a water solution, is bitter, irritating, or caustic to the skin and has a pH value greater than 7.0. Alkali/water solutions turn litmus blue. Examples include sodium hydroxide and sodium carbonate (soda ash).

Alkali metals: Metals (in Group IA of the Periodic Table,) such as lithium, sodium, potassium, rubidium, cesium, and francium. Except for francium, the alkali metals are all soft, silvery metals, which may be readily fused and turned into vapor, the melting and boiling points becoming lower with increasing atomic weight. They react vigorously, at times violently, with water. These metals present a dangerous fire risk when in contact with moisture or oxidizing materials.

Alkaline earth metals: Calcium, barium, strontium, and radium (Group IIA of Periodic Table). In general alkaline earth metals are various shades of white, malleable, extrudable, and machinable, and may be made into rods, wire, or plate. These are less reactive than sodium and potassium and have higher melting and boiling points.

Alkyl: A straight or branched hydrocarbon group, which may be derived by dropping one hydrogen molecule from the chemical formula. Examples are methyl, CH_3-; ethyl, C_2H_5-; propyl, $CH_3CH_2CH_2$-; and isopropyl, $(CH_3)2CH_3$-.

Allergen: A substance that may produce an allergic reaction (e.g., plant pollens, some chemicals). Allergens produce antibodies when they come into contact with body tissues by inhalation, ingestion or skin absorption.

Amines: A class of organic compounds of nitrogen that may be considered as derived from ammonia WHO by replacing one or more of the hydrogen atoms (H) with straight or branched hydrocarbon (alkyl) groups. All amines are basic in nature and usually combine readily with hydrochloric or other strong acids to form salts.

Ammonracal: Relating to, containing, or having the properties of ammonia.

Amyl nitrate pearle: This is a drug used in treating the effects of cyanide poisoning.

Anhydrous: Free from water.

Anion: A negatively charged ion; when put in a liquid subjected to electric potential, anions collect at the positive pole or anode. Examples are hydroxyl, OH-; carbonate, $C0_3$-; and phosphate, $P0_4$-.

Anoxia: A condition where the deficiency of oxygen reaching the tissues of the body is of such severity that it results in permanent damage.

Anuria: Absence or a defect in the excretion of urine.

Aqueous: Relating to or resembling water; made from, with, or by water.

Aromatic: A major group of hydrocarbons containing one or more rings like benzene, which has a six-carbon ring containing three double bonds. Most compounds in this group are derived from petroleum and coal tar and are reactive and chemically versatile. The name characterizes the strong and pleasant odor of most substances of this group. *Note:* The term "aromatic" is often used in perfume and fragrance industries to describe essential oils, which are not aromatic in the chemical sense.

Asphyxiation: An action to kill or to make unconscious through lack of adequate oxygen.

Autoignition Temperature: The minimum temperature at which the material will ignite without a spark or flame being present. Along with the flash point, autoignition temperature gives an indication of relative flammability.

Azeotrope: A liquid mixture of two or more substances, which behaves like a single substance in that the vapor produced by partial evaporation of the liquid, has the same composition as the liquid.

Base: Bases are caustic and corrosive to skin, eyes, and mucous membranes. The pH range of base solutions is from 7.1 to 14. This class of compounds has one or more of the following properties: bitter taste, slippery feeling in solution, ability to turn litmus blue, ability to react with (neutralize) acids to form salts. This includes both hydroxides and oxides of metals.

Behavior in Fire: Any characteristic behavior that might increase significantly the hazard presented by the burning material (e.g., dense smoke, flammable vapors, toxic smoke, polymerization or explosion potential).

Blepharaspasm: A twitching or spasmodic contraction of one of the eye muscles due to habit, spasm, eyestrain, or nervous irritability.

Blephar: Eyelid; cilium; flagellum.

BLEVE: Boiling Liquid Expanding Vapor Explosion. In addition to its technical meaning, this acronym has acquired a common usage definition in which the term has come to stand for virtually any rupture of a tank of liquid or liquefied compressed gas. It has been expanded to include all vapor explosions. The technical definition of BLEVE presents the hypothesis that rapid depressurization of a hot, saturated liquid may result in an explosion. The temperature of the hot liquid must be above the superheat limit temperature at one atmosphere and the drop in tank pressure must be very rapid. This requires instantaneous homogeneous nucleation of the hot liquid. This phenomenon has NOT been observed as the cause of a failure of a transportation container. See the discussion about BLEVE in the Introduction.

Boiling Point: The temperature at which the material boils.

Burning Rate: The rate, in millimeters per minute, at which the depth of a pool of a liquid decreases as the liquid burns.

Carbonate: A salt or ester of carbonic acid. These compounds result from the reaction of either a metal or an organic compound with carbonic acid. The reaction with a metal yields a salt (i.e., calcium carbonate), and that with an organic compound forms an ester, (i.e., diethyl carbonate, or diphenyl carbonate).

Cation: An ion having a positive charge. Cations in a liquid subjected to electric potential collect at the negative pole or cathode.

Chemical Abstract Service (CAS) Number: Often used by state and local Right-To-Know regulations for tracking chemicals in the workplace and the community. Sometimes referred to as a chemical's "social security number." Sequentially assigned CAS numbers identify specific chemicals and have no chemical significance.

Chemical Formula: The most common chemical formula or formulation for the commodity.

Chemically active metals: This phrase generally refers to metals such as aluminum, calcium, magnesium, potassium, sodium, tin, zinc, and their alloys.

Chronic exposures: A chronic exposure to a chemical is one that takes place repeatedly over a long period of time. Chronic exposures are typically associated with long-term presence of chemical contaminants in an individual's environment or place of work.

Chronic: Marked by long duration or frequent recurrence; the opposite of acute.

Cold Zone: See Hazard Control Zones.

Color of the Shipped Material: Normal observed color of the material.

Common Uses: Primary commercial and household uses of the commodity.

Conditions to Avoid: Conditions that increase the level of hazard when encountered by the commodity.

Conjunctiva: The mucous membrane that lines the inner surface of the eyelids and is continued over the forepart of the eyeball.

Consequence: A potentially adverse result of implementing a given technique.

Constituent Components (% each): Typical product purity for single component materials or components of mixtures, including typical added stabilizers and inhibitors.

Cornea: The transparent part of the coat of the eyeball that covers the iris and pupil and admits light to the interior of the eye.

Corrosiveness: The ability of the commodity to react with, specifically to reduce or oxidize, commonly encountered materials such as metal, glass, rubber, etc.

Defatting: To remove or eliminate fat.

Delirium: A condition of mental excitement, confusion, and clouded sensorium, usually with hallucinations, illusions, and delusions. It is precipitated by toxic factors in diseases or drugs.

Dermatitis: Inflammation of the skin.

Edema: An abnormal accumulation of watery fluid in connective tissue or in a watery cavity; this water accumulation may cause swelling.

Encephalo-: A prefix meaning brain.

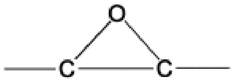
Encephalopathy: Disease of the brain.

Epinephrine: A hormone of the adrenal glands that is readily soluble in aqueous solutions of mineral acids, sodium hydroxide, and potassium hydroxide. It is used as a heart stimulant, a vasoconstrictor, and a muscle relaxant.

Epidermis: The outer layer of the skin of an animal with a backbone.

Epithelium: A tissue composed of cells that have a minimum of substances between them. It forms the epidermis (skin) and lines hollow organs and all passages of the respiratory, digestive, genital, and urinary organs.

Epoxide: An organic compound containing a reactive group resulting from the union of an oxygen atom with other atoms (usually carbon) that are joined as shown below:



This group, commonly called "epoxy," characterizes the epoxy resins. Epichlorohydrin and ethylene oxide are well-known epoxides.

Erythema: Abnormal redness of the skin due to capillary congestion (as in inflammation).

Evaporation Rate. The rate at which a particular substance will vaporize (evaporate) when compared to the rate of a known substance typically n-butyl acetate, but also can be compared to ethyl ether. This term is especially useful for health and fire-hazard considerations.

Evacuate means move all people from a threatened area to a safer place. To perform an evacuation, there must be enough time for people to be warned, to get ready, and to leave an area. If there is enough time, evacuation is the best protective action. Begin evacuating people nearby and those outdoors in direct view of the scene. When additional help arrives, expand the area to be evacuated downwind and crosswind to at least the extent recommended in this guidebook. Even after people move to the distances recommended, they may not be completely safe from harm. They should not be permitted to congregate at such distances. Send evacuees to a definite place, by a specific route, far enough away so they will not have to be moved again if the wind shifts.

Exothermic: A process or chemical reaction that is accompanied by evolution of heat, as combustion reactions.

Explosion proof equipment: Equipment that will not spark and is intrinsically safe.

Explosiveness: An indication of the susceptibility of the material to detonation by spark, shock, fire, etc.

Extinguishing Materials: Materials that may be used to extinguish the burning commodity.

Extinguishing Techniques: Techniques that may be used to extinguish the burning commodity.

First Aid for Ingestion: Initial first aid treatment for persons who have swallowed the commodity.

First Aid for Inhalation: Initial first aid treatment for persons who have breathed the airborne commodity.

First Aid for Skin and Eye Contact: Initial first aid treatment for persons suffering from skin or eye contact with the commodity.

Flammable (Explosive) Range; The range of gas or vapor concentration (percentage by volume in air) that will burn or explode if an ignition source is present. Limiting concentrations are commonly called the "lower flammable (explosive) limit" and the "upper flammable (explosive) limit." Below the lower flammable limit, the mixture is too lean to burn; above the upper flammable limit, the mixture is too rich to burn. If the gas or vapor is released into an oxygen enriched atmosphere, the flammable range will expand. Likewise, if the gas or vapor is released into an oxygen deficient atmosphere, the flammable range will contract.

Flash Point: The lowest temperature at which vapors above a volatile, combustible, substance will ignite in air when exposed to a flame. This gives an indication of the relative flammability of the material.

Flocculant: A substance that causes clumping (flocculation). Flocculants are used in water purification, liquid waste treatment, and other special applications. Inorganic flocculants are lime, alum, and ferric chloride. Polyelectrolytes are examples of organic flocculants.

Freezing Point: The temperature at which a material changes from a liquid to a solid.

Frostbite: The freezing or the local effect of a partial freezing of some part of the body.

Full protective clothing: This phrase refers to the fully encapsulating suits discussed in the Protective Clothing sections of the guides. Such suits are typically recommended where high chemical gas, vapor, or fume concentrations in air may have a corrosive effect on exposed skin and/or where the chemical in air may be readily absorbed through the skin to cause toxic effects. These suits are impervious to chemicals, offer full body protection, and include self-contained breathing apparatus (SCBA).

Fully encapsulating suits: This includes full chemical protective suits that are impervious to chemicals, offer full body protection from chemicals and their vapors/ fumes, and are to be used with self-contained breathing apparatus (SCBA).

Fume: The particulate, smoke-like emanation from the surface of heated metals. The vapor evolved from concentrated acids (sulfuric, nitric), from evaporating solvents or as a result of combustion or other decomposition reactions (exhaust fume). Many of these fumes are toxic.

General Cleanup Information: Non-specific approaches to cleaning up spilled material.

Halogen: One of the electronegative elements of Group VII A of the Periodic Table: fluorine, chlorine, bromine, iodine, and astatine. Fluorine is the most active of all chemical elements.

Hazard to Skin and Eye Contact: Situations that may result from skin or eye contact with the commodity.

Hazard Class: The hazard class shown in the guides is that currently used by the U.S. DOT and is published in 49 CFR §172.101. This hazard class represents the main hazard of the commodity in U.S. transportation. The hazard classes used in the U.S. are: explosives (Class 1), flammable gas (Division 2.1, non-flammable gas (Division 2.2), poison (or toxic) gas (Division 2.3, flammable liquid (Class 3), combustible liquid, flammable solid (Division 4.1), spontaneously combustible material (Division4.2), dangerous when wet material (Division 4.3), oxidizer (Division 5.1), organic peroxide (Division .2), poisonous material (Division 6.1), infectious substance (Division 6.2), radioactive material (Class 7), corrosive materials (Class 8), and miscellaneous hazardous material (Class 9).

Hazard Control Zones: The designation of areas at a hazardous materials incident based upon safety and the degree of hazard. Many terms are used to describe these hazard control zones; however, for the purposes of this text, these zones are defined as the hot, warm and cold zones.

Hot Zone: An area immediately surrounding a hazardous materials incident, which extends far enough to prevent adverse effects from hazardous materials releases to personnel outside the zone. This zone is also referred to as the “exclusion zone”, the “red zone”, and the “restricted zone” in other documents. Law enforcement personnel may also refer to this as the inner perimeter.

Warm Zone: The area where personnel and equipment decontamination and hot zone support takes place. It includes control points for the access corridor and thus assists in reducing the spread of contamination. This is also referred to as the “decontamination”, “contamination reduction”, “yellow zone”, “support zone”, or “limited access zone” in other documents.

Cold Zone: The hazard control zone of a hazmat incident that contains the incident command post and other support functions as are deemed necessary to control the incident. This zone may also be referred to as the clean zone or the support zone.

Hazardous Combustion Products: Any known materials in smoke from which may be hazardous.

Hazards of Ingestion: Situations that may result from introduction of the commodity into the gastrointestinal tract (e.g., swallowing).

Hazards of Inhalation: Situations that may result from breathing the airborne commodity.

HazMat Code (49 Series): The HazMat 49 series Code is a seven digit code that is used by the railroads to identify specific hazardous materials moving in their systems.

HCN: Hydrogen cyanide

Heat of Combustion: Amount of heat liberated during combustion one gram of material.

Hemoglobinuria: The presence of free hemoglobin (a blood protein) in the urine.

Hemoglobin: The respiratory protein of the red blood cells. It transfers oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs.

Hemolysis: Liberation of hemoglobin from red blood cells.

Hemorrhage: An escape of blood from the vessels and organs either through intact walls or by flow through ruptured walls.

Hemorrhagic gastritis: The escape of blood from a ruptured vessel(s) within the lining of the stomach.

Hepatomegaly: Enlargement of the liver.

Hot Zone: See Hazard Control Zones.

Hydrocarbon: An organic compound (as acetylene or benzene) consisting exclusively of the elements carbon and hydrogen and often occurring in petroleum, natural gas, coal, and bitumens.

IMDG Designation: A hazardous material identifier published by the International Maritime Organization in their Dangerous Goods Code.

Immediately Dangerous to Life or Health (IDLH): An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

IMO: International Maritime Organization, London.

Impervious: Not allowing entrance or passage, impenetrable.

Insidious: Having a gradual and cumulative effect; developing so gradually as to be well established before becoming apparent.

Iridocyclitis: Inflammation of the iris and the lens of the eye.

Isolating the Scene: The process of preventing persons and equipment from becoming exposed to a actual or potential hazmat release. Includes establishing isolation perimeter and control zones.

Isolation Perimeter: The designated crowd control line surrounding the Hazard Control Zones. The isolation perimeter is always the line between the general public and the Cold Zone. Law enforcement personnel may also refer to this as the outer perimeter.

Isotopes: Any of two or more species of atoms of a chemical element with the same atomic number and position in the Periodic Table. These species have nearly identical chemical behavior but with differing atomic mass or mass number and different physical properties.

Lacrimation: The secretion of tears especially when abnormal or excessive; crying.

Lower Explosive Limit: See Flammable (Explosive) Range.

Lower Flammable Limit: See Flammable (Explosive) Range.

LRQ: Local Reportable Quantity—used only in these guides to identify the reportable quantity of extremely hazardous substance under SARA when no CERCLA reportable quantity has been established.

Malaise: An indefinite feeling of debility or lack of health often indicative of or accompanying the onset of an illness; a vague sense of ill-being.

Mania: Excitement manifested by mental and physical hyperactivity, disorganization of behavior, and elevation of mood; excessive or unreasonable enthusiasm.

Melting Point: The temperature at which the material changes from a solid to a liquid. (See freezing point)

Methemoglobinemia: The presence of methemoglobin, a blood pigment, in the blood that causes cyanosis (a bluish purplish coloring of the skin and lips), dizziness, headache, diarrhea, and anemia.

Mitigation: Techniques that may be used to control the negative results of implementing a response technique.

Molecular Weight: (also known as formula weight) The weight of the molecule; the sum of the atomic weight of its constituent atoms. This weight is usually computed to nearest hundredth.

Mordant: A substance capable of binding a dye to a textile fiber. The most important mordants are trivalent chromium complexes, metallic hydroxides, tannic acid, etc. Mordants are used with acid dyes, basic dyes, direct dyes, and sulfur dyes. Premetalized dyes contain chromium in the dye molecule. A mordant dye is a dye requiring use of a mordant to be effective.

NA: North American-When this precedes a four digit number, it indicates that this identification number is used in the United States to identify a commodity or group of commodities.

NFPA: National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

NFPA 704: A system used by the National Fire Protection Association to simplify determining the degree of health, flammability and instability hazards of chemicals. The system also provides for the recognition of unusual water reactivity and oxidizers. The *NFPA 704* ratings are displayed in markings that are commonly referred to as the "NFPA hazard diamond", which is discussed in Appendix B. The "NFPA hazard diamond' is shown on page 3 of each of the Guides.

NIOSH: National Institute of Occupational Safety and Health, 4676 Columbia Parkway Cincinnati, OH 45226.

Narcosis: A state of stupor, unconsciousness, or arrested activity produced by the influence of narcotics or other chemicals.

Nitride: Compounds of nitrogen with N= as the anion. These compounds may react with moisture to evolve flammable ammonia gas.

Non-Specific Symptoms: Catalog of symptoms which may appear when the person is exposed the commodity and the route of entry is not known.

Odor Characteristics: The perceived quality and comparative characteristics of the odor of the material.

Olefin: Organic compounds with straight or branched chain carbon arrangement of the atoms that contain at least one double bond. They are named by adding "- ene", or "-ylene" to the base chemical name, e.g., octene, ethylene, and propylene.

Opacification: The process of becoming opaque and impervious to light such as in the opacity of the cornea or lens.

Opacity: The optical density of a material, usually a pigment.

OSHA: Occupational Safety and Health Administration, 950 Upshur Street, N.W., Washington, D.C. 20011.

Oxidizing materials: Any compound that spontaneously evolves oxygen either at room temperature or under slight heating. The term includes such chemicals as peroxides, chlorates, perchlorates, nitrates, and permanganates. These can react vigorously at ambient temperatures when stored near or in contact with reducing materials such as cellulosic (i.e., cotton, paper, rayon) and other organic compounds. In general, storage areas for oxidizing materials should be well ventilated and kept as cool as possible.

Photophobia: Intolerance or sensitivity to light.

Physical State as Released: Whether the material is released as a solid, liquid, or gas.

Physical State as Shipped: Whether the material is shipped as a solid, liquid, or gas.

Pneumo-: A prefix that means air, gas, lung, or pulmonary; i.e., pneumothorax.

Pneumonitis: Inflammation of the lung.

Polymerization: A chemical reaction, usually carried out with a catalyst, heat, or light, and often under high pressure. In this reaction a large number of relatively simple molecules combine to form a chain-like macromolecule. This reaction can occur with the release of heat. In a container, the heat associated with polymerization may cause the substance to expand and/ or release gas and cause the container to rupture, sometimes violently. The polymerization reaction occurs spontaneously in nature; industrially it is performed by subjecting unsaturated or otherwise reactive substances to conditions that will bring about the combination.

Protection In-Place: See Shelter-In Place.

Protective Clothing Required: Characteristics and OSHA criteria for required protection against contact with the material.

Pulmonary: Relating to or associated with the lung.

Pulmonary edema: A condition in which watery fluid fills the air vesicles and interstitial tissue of the lungs.

Reactivity with Other Chemicals: Chemical reactivity with common industrial or research chemicals, including rates and products if known.

Reactivity with Water: Chemical reactivity with water, including rates and products if known.

Reducing agents: These agents act to extract and liberate hydrogen from organic substances and may generate toxic and/or flammable gases and heat in contact with water. Many reducing agents may be pyrophoric and may ignite combustible materials in the presence of air. Contact with oxidizing materials may result in violent or explosive reactions. Examples of reducing agents include calcium, phosphorus, sodium, hydrazine, arsine, and metallic acetylides, aluminates, boranes, bromides, carbides, chlorides, hydrides, hydroborates, hyposulfites, iodides, phosphides, selenides, and silanes, as well as metal alkyls such as triethyl aluminum and diethyl zinc.

Reportable Quantity: The minimum amount of the substance spilled in the United States that must be reported to the National Response Center at 800-424-8002; in DC 202-426-2675.

Respiratory Protection Requires: Characteristics with OSHA criteria for required protection against inhalation of the material.

SCBA: Self-contained breathing apparatus.

Serous: Thin watery constitution.

Shipping Names: Synonyms under which the commodity may be shipped legally.

Shelter In-Place means people should seek shelter inside a building and remain inside until the danger passes. Sheltering in-place is used when evacuating the public would cause greater risk than staying where they are, or when an evacuation cannot be performed. Direct the people inside to close all doors and windows and to shut off all ventilating, heating and cooling systems. In-place protection may not be the best option if (a) the vapors are flammable; (b) if it will take a long time for the gas to clear the area; or (c) if buildings cannot be closed tightly. Vehicles can offer some protection for a short period if the windows are closed and the ventilating systems are shut off. Vehicles are not as effective as buildings for in-place protection.

Short Term Exposure Limit (STEL): See definition for Threshold limit value (TLV).

Solubility in Other Chemicals: Solubility of the commodity in non-aqueous solvents (i.e., not water). The same conventions as for solubility in water are used (i.e., soluble, insoluble, etc.).

Solubility in Water: Whether or not the material dissolves in water. Range is from insoluble, slightly soluble, soluble, very soluble, to miscible or soluble in all proportions.

Specific Gravity (Liquid): Ratio of the density of the commodity to the density of water. If greater than one, the material will sink; if less than one, the material will float.

Sputum: Expectorated matter made of saliva discharged from the respiratory passages; spit.

Splenomegaly: Enlargement of the spleen.

Stability: The potential for decomposition of the material during shipment. This rating *does not* apply during a fire.

STEL: Short Term Exposure Limit—see definition for Threshold limit value.

Sublime: To cause to pass from the solid to the vapor state by heating and again condensing to solid form (without going through the liquid state).

Substernal: Beneath the sternum (breastbone).

Synonyms and Trade names: Alternative systematic chemical names and commonly used names, including commercial or trade names.

Techniques: Techniques, which have been used to contain, or otherwise control the spilled commodity.

Tepid: Moderately warm.

Threshold Odor Concentration: The lowest concentration in air at which most people can detect and/or recognize the odor of the material.

Time Weighted Average (TLV-TWA): See definition for Threshold Limit Value.

TLV: Threshold Limit Value. Threshold Limit Values are specified as follows:

Threshold Limit Value/Ceiling (TLV/C):. The maximum concentration that should not be exceeded, even instantaneously. The lower the value, the more toxic the substance.

Threshold Limit Value/Short Term Exposure Limit (TLV/STEL): The 15-minute, time-weighted average exposure which should not be exceeded at any time, nor repeated more than four times daily with a 60-minute rest period required between each STEL exposure. The lower the value, the more toxic the substance.

Threshold Limit Value/Skin (Skin): Indicates a possible and significant contribution to overall exposure to a material by absorption through the skin, mucous membranes, and eyes by direct or airborne contact.

Threshold Limit Value/Time Weighted Average (TLV/TWA): The airborne concentration of a material to which an average, healthy person may be exposed repeatedly for 8 hours each day, 40 hours per week, without suffering adverse effects. The young, old, ill and naturally susceptible will have lower tolerances and will need to take additional precautions. TLVs are based upon current available information and are adjusted on an annual basis by organizations such as the American Conference of Governmental Industrial Hygienists (ACGIH). As TLVs are time weighted averages over an eight-hour exposure, they are difficult to correlate to emergency response operations. The lower the value, the more toxic the substance.

Toxicity: The quality of being toxic or poisonous; the kind and amount of poison or toxin produced by a microorganism.

TWA: Time Weighted Average-see definition for Threshold Limit Value.

Ulceration: The process that produces a break in skin or mucous membrane with loss of surface tissue, disintegration, and localized death of epithelial tissue. The break often festers and has an open sore.

UN: United Nations-When this precedes a 4-digit number, it indicates that this identification number is used internationally to identify a commodity or group of commodities.

Unusual Hazards: Any special hazards displayed by the material.

Upper Explosive Limit: See Flammable (Explosive) Range.

Upper Flammable Limit: See Flammable (Explosive) Range.

USDOT: United States Department of Transportation, 400 Seventh Street, S.W., Washington, D.C. 20590.

Vapor: An air dispersion of molecules of a substance that is liquid or solid in its normal state, i.e., at standard temperature and pressure. Examples are water vapor and benzene vapor. Vapors of organic liquids are also loosely called fumes.

Vapor Density: The ratio of the vapor density of the commodity compared to that of air. If the ratio is greater than 1, the vapors are heavier and may settle to the ground; if lower than 1, the vapors will rise.

Vapor Pressure: The pressure of the vapor in equilibrium with the liquid at the specified temperature. Higher values indicate higher volatility.

Ventricular fibrillation: An alteration in the rhythm of the heartbeat characterized by extremely rapid, irregular, and ineffective twitching of the heart chambers (ventricles). Ventricular fibrillation is a frequent cause of cardiac arrest.

Ventricle: A chamber of the heart that receives blood from a corresponding atrium and from which blood is forced into the arteries.

Warm Zone: See Hazard Control Zones.

APPENDIX E
SOURCES OF INFORMATION AND ASSISTANCE

INFORMATION SOURCE	TYPE OF ORGANIZATION	TYPE OF INFORMATION ASSISTANCE	ACCESS
Chemical Transportation Emergency Center (CHEMTREC)	Industry Sponsored	2,3	Through CHEMTREC 800/424-9300, 24 hour 703/527-3837
Chlorine Emergency Plan (CHLOREP	Industry Sponsored	1,2,3	Through CHEMTREC 800/424-9300, 24 hour 703/527-3837
EPA Oil & Hazardous Materials Technical Assistance Data System (OHMTADS)	Federal	2,4	703/603-8707 www.epa.gov./NRPM
National Response Teams (EPA, USCG)	Federal	1	National Response Center 800/424-8802
U.S. Army technical Escort Center Chemical Emergency Response Team	Federal	1	Dept. of Army Operation Center 703/521-2185
CANUTEC Transport Canada Transport Dangerous Goods 112112 Kent Street Tower B—3rd Floor Ottawa, ON K1A ON5	Canadian government	2,3	Emergency—613/996-6666 Information—613/992-4624

1. Respond to scene with trained personnel if required.
2. Provide information on identity, hazards, or what to do.
3. Refer to knowledgeable contact.
4. On-line computer available.

STATE SOLID AND HAZARDOUS WASTE AGENCIES
Environmental Protections Agency
Office of Solid Waste

ALABAMA

Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd
Montgomery, Alabama 36110
CML (334) 271-7700

ALASKA

Dept. of Environmental Conservation
Division of Environmental Quality
410 Willoughby Ave., Suite 303
Juneau, Alaska 99801-1795
CML (907) 465-5010

ARIZONA

Waste Programs Division
Arizona Department of Environmental Quality
3033 North Central Avenue
Phoenix, Arizona 85012-2809
CML (602) 207-4208

ARKANSAS

Department of Environmental Quality
P.O. Box 8913
8001 National Drive
Little Rock, Arkansas 72209
CML Solid Waste Division (501) 682-0600
CML Hazardous Waste Division (501) 682-0833

CALIFORNIA

Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806
CML (916) 323-9723

Integrated Waste Management Board
1001 I St
P.O. Box 4025
Sacramento, California 95812-4025
CML (916) 341-6000

COLORADO

Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Dr. South
Denver, Colorado 80222
CML (303) 692-3300

CONNECTICUT

Bureau of Waste Management
Department of Environmental Protection
79 Elm Street
Hartford, Connecticut 06102-5127
CML (860) 424-3024

DELAWARE

Air and Waste Management Division
Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, Delaware 19901
CML (302) 739-4764

DISTRICT OF COLUMBIA

Environmental Health Administration
Bureau of Hazardous Materials & Toxic Substances
51 N Street, S.E., 3rd floor
Washington, DC 20002
(202) 535-2270

FLORIDA

Division of Waste Management
Department of Environmental Regulation
2600 Blair Stone Road
Mail Station 4500
Tallahassee, Florida 32399-2400
CML (850) 487-3299

GEORGIA

Department of Natural Resources
Environmental Protection Division, Land Protection Branch
4244 International Parkway, Suite 104
Atlanta, Georgia 30354
CML (404) 362-2537

Department of Natural Resources
Environmental Protection Division
Hazardous Waste Management Branch
205 Butler St., SE, Suite 1154
East Tower
Atlanta Georgia 30334
CML (404) 656-7802

GUAM

Guam Environmental Protection Agency
Air and Land Programs
IT&E Harmon Plaza
Complex Unit D-107
130 Rojas Street
Harmon, Guam 96911
Overseas Operator
(Commercial Call-671-472-8863)

HAWAII

Department of Health
Hazardous Waste Branch
919 Ala Moana Boulevard, Suite 206
Honolulu, Hawaii 96814
CML (808) 586-4226

IDAHO

Division of Environmental Quality
Department of Health and Welfare
Hazardous Materials Bureau
1410 North Hilton Street
Boise, Idaho 83706
CML (208) 373-0287

ILLINOIS

Bureau of Land
Environmental Protection Agency
1021 North Grande Ave, East
P.O. Box 19276
Springfield, Illinois 62794-9276
CML (217) 782-6761

INDIANA

Office of Environmental Response
Department of Environmental Management
P.O. Box 6015, 100 North Senate St.
Indianapolis, IN 46206-6015
CML (317) 233-6350

Office of Land Quality
Department of Environmental Management
100 North Senate Street
P.O. Box 6015
Indianapolis IN 46206-6015
CML (317) 232-8941

Office of Pollution Prevention
Department of Environmental Management
150 West Market Street, Suite 703
Indianapolis IN 46206-6015
CML (317) 232-5964

IOWA

Department of Natural Resources
Waste Management Assistance Bureau
502 E 9th Street
Wallace State Office Building
Des Moines, Iowa 50319-0034
CML (515) 281-4367

KANSAS

Bureau of Waste Management
Department of Health and Environment
Forbes Field, Building 740
Topeka, Kansas 66620
CML (785) 296-1612

KENTUCKY

Division of Waste Management
Department for Environmental Protection
Frankfort Office Park
14 Reilly Road
Frankfort, Kentucky 40601
CML (502) 564-6716 Ext. 214

LOUISIANA

Office of Solid and Hazardous Waste
Department of Environmental Quality
P.O. Box 82178
Baton Rouge, Louisiana 70884
CML (504) 765-0261

MAINE

Bureau of Oil & Hazardous Materials Control
Dept. of Environmental Protection
State House Station #17
Augusta, Maine 04333
CML (207) 287-2651

MARYLAND

Maryland Waste Management Administration
Dept. of the Environment
2500 Broening Highway
Baltimore, Maryland 21224
CML (410) 631-3314

MASSACHUSETTS

Bureau of Waste Site Cleanup
Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108
CML (508) 946-2850

Department of Environmental Protection
Bureau of Waste Prevention
Division of Solid Waste Management
One Winter Street
4th Floor
Boston, Massachusetts 02108
CML (508) 946-2828

MICHIGAN

Environmental Response Division
Department of Natural Resources
Box 30426
300 South Washington Square
Lansing, Michigan 48909
CML (517) 373-9837

MINNESOTA

Minnesota Pollution Control Agency
Hazardous Waste Division
520 Lafayette Road North
St. Paul, MN 55155
CML (651) 296-5763

Minnesota Pollution Control Agency
Ground Water and Solid Waste Division
520 Lafayette Road North
St. Paul, MN 55155
CML (651) 296-7777

Minnesota Office of Waste Management
1350 Energy Lane, Suite 201
St. Paul, Minnesota 55108

MISSISSIPPI

Department of Environmental Quality
Office of Pollution Control
Hazardous Waste Division
2380 Highway 80 West, P.O. Box 10385
Jackson, MS 39289
CML (601) 961-5171

Department of Environmental Quality
Office of Pollution Control
Ground Water Protection Division
2380 Highway 80 West, P.O. Box 10385
Jackson, MS 39289
CML (601) 961-5171

MISSOURI

Department of Natural Resources
Division of Environmental Quality
Hazardous Waste Management Program
1738 East Elm St., P.O. Box 176
Jefferson City, MO 65102
CML (573) 751-3176

Department of Natural Resources
Division of Environmental Quality
Solid Waste Program
1738 East Elm St., P.O. Box 176
Jefferson City, MO 65102
CML (573) 751-5401

Department of Natural Resources
Division of Environmental Quality
Underground Storage Tanks
1738 East Elm St., P.O. Box 176
Jefferson City, MO 65102
CML (573) 751-1300

MONTANA

Solid & Hazardous Waste Bureau
Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620
CML (406) 444-2544

NEBRASKA

Department of Environmental Quality
1200 N St., Suite 400
Lincoln, Nebraska 68508
CML (402) 471-2186

NEVADA

Bureau of Waste Management
Division of Environmental Protection
123 W. Nye Lane, Rm 120
Carson City, Nevada 89706-0851
CML (775) 687-4670

NEW HAMPSHIRE

Waste Management Division
Department of Environmental Services
6 Hazen Drive
Concord, New Hampshire 03301-6509
CML (603) 271-2942

NEW JERSEY

Department of Environmental Protection and Energy
Division of Solid Waste Management
401 E State St, P.O. Box 414
Trenton, NJ 08625
CML (609) 984-2080

Department of Environmental Protection and Energy
Environmental Regulation
401 E State St, P.O. Box 423
Trenton, NJ 98625
CML (609) 292-2795
Department of Environmental Protection and Energy
Site Remediation Program
401 E State St, P.O. Box 028
Trenton, NJ 08625
CML (609) 292-1250

Department of Environmental Protection and Energy
Site Remediation Program
Division of Responsible Party Site Remediation
401 E State St, P.O. Box 028
Trenton, NJ 08625
CML (609) 984-1688

NEW MEXICO

Environment Department
604 West San Mateo Street
Santa Fe, New Mexico 87505
CML (505) 827-1557

NEW YORK

Department of Environmental Conservation
Division of Solid and Hazardous Materials and Bureau of Waste Reduction & Recycling
50 Wolf Rd., Rm 212
Albany, NY 12233
CML (518) 457-7337

Department of Environmental Conservation
Division of Water
50 Wolf Rd.
Albany, NY 12233-3500
CML (518) 457-5968

Department of Environmental Conservation
Pollution Prevention Unit
50 Wolf Rd., Room 298
Albany, NY 12233-8010
CML (518) 457-2553

NORTH CAROLINA

Department of Environment, Health and Natural Resources
Division of Solid Waste Management
401 Oberlin Rd., Suite 150
Raleigh, North Carolina 27605
CML (919) 733-0692

NORTH DAKOTA

Division of Waste Management
State Department of Health
1200 Missouri Ave., Room 302
Box 5520
Bismarck, North Dakota 58502-5520
CML (701) 328-5166

OHIO

Division of Solid & Infectious Waste Management
Ohio Environmental Protection Agency
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215
CML (614) 644-2621

Division of Emergency and Remedial Response
Ohio Environmental Protection Agency
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215
CML (614) 644-2924

Division of Hazardous Waste Management
Ohio Environmental Protection Agency
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215
CML (614) 644-2917

OKLAHOMA

Waste Management Division
Dept. of Environmental Quality
700 North Robinson St.
P.O. Box 1677
Oklahoma City, Oklahoma 73101-1677
CML (405) 702-5100

OREGON

Hazardous & Solid Waste Division
Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, Oregon 97204-1390
CML (503) 229-5913

Waste Management and Cleanup Division
Department of Environmental Quality
811 S.W. Sixth Ave.
Portland, OR 97204-1390
CML (503) 229-5072

PENNSYLVANIA

Bureau of Waste Management
Pennsylvania Department of Environmental Protection
P.O. Box 8471
14th Floor, MSSOB
400 Market St.
Harrisburg, Pennsylvania 17105
CML (717) 783-2388

RHODE ISLAND

Office of Waste Management
Dept. of Environmental Management
235 Promenade St.
Providence, Rhode Island 02908-5767
CML (401) 222-2797

SOUTH CAROLINA

Department of Health & Environmental Control
2600 Bull Street
Columbia, South Carolina 29201
CML (803) 898-3432

SOUTH DAKOTA

Department of Environment & Natural Resources
Division of Environmental Services
Foss Building
523 East Capitol
Pierre, South Dakota 57501
CML (605) 773-3153

TENNESSEE

Department of Environment and Conservation
Division of Superfund
401 Church Street
4th Floor, L&C Annex Building
Nashville, TN 37243-1538
CML (615) 532-0909

Department of Environment and Conservation
Division of Solid Waste Management
5th Floor, L&C Tower
401 Church Street
Nashville, TN 37243-1535
CML (615) 532-0780

TEXAS

Municipal Solid Waste Division
Texas Natural Resource Conservation
12100 Part 35 Circle
Austin, Texas 78753
CML (512) 239-6695

Industrial and Hazardous Waste Division
Texas Natural Resource Conservation Commission
12100 Part 35 Circle
Austin, Texas 78753
CML (512) 239-6832

Pollution Cleanup Division
Texas Natural Resource Conservation Commission
12100 Part 35 Circle
Austin, Texas 78753
CML (512) 239-0310

Petroleum Storage Tank Division
Texas Natural Resource Conservation Commission
12100 Part 35 Circle
Austin, Texas 78753
CML (512) 239-2000

UTAH

Division of Solid and Hazardous Waste
Department of Environmental Quality
288 North 1460 West
Salt Lake City, Utah 84116
CML (801) 538-6170

Division of Environmental Response and Remediation
Department of Environmental Quality
168 North 1950 West
Salt Lake City, UT 84116
CML (801) 536-4100

VERMONT

Waste Management Division
Dept. of Environmental Conservation
103 South Main Street, West Building
Waterbury, Vermont 05671-0404
CML (802) 241-3888

VIRGINIA

Department of Environmental Quality
P.O. Box 10009
629 East Main St., 10th Floor
Richmond, Virginia 23219
CML (800) 468-8892

WASHINGTON

Hazardous Waste & Toxic Reduction Program
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600
CML (360) 407-6700

WEST VIRGINIA

Waste Management
West Virginia Division of Environmental Protection
1356 Hansford St.
Charleston, West Virginia 25301
CML (304) 558-6350

WISCONSIN

Bureau of Solid Waste Management
Division for Environmental Quality
Dept. of Natural Resources
2300 N Dr. Martin Luther King Jr Drive
P.O. Box 12436
Milwaukee, Wisconsin 53212
CML (414) 263-8500

WYOMING

Division of Solid Waste
Dept. of Environmental Quality
122 West 25th Street
Herschler Bldg.
Cheyenne, Wyoming 82002
CML (307) 777-7752

REGIONAL OIL AND HAZARDOUS MATERIAL COORDINATORS
Environmental Protection Agency

EPA, REGION I

John F. Kennedy Federal Building
One Congress Street
Room 1100
Boston, MA 02114-2023
617/918-1111 or
800/372-7431 in Region 1

EPA, REGION II

Region 2
290 Broadway
26th Floor
New York, NY 10007-1866
212/637-5000

EPA, REGION III

Region 3
1650 Arch Street
Philadelphia, PA 19103-2029
215/814-5000, or
800/438-2474 in Region 3

EPA, REGION IV

Region 4
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-3104
404/562-9900

EPA, REGION V

Region 5
77 West Jackson Blvd
Chicago, IL 60604
312/353-2000, or
800/621-8431 in Region 5

EPA, REGION VI

Region 6
1445 Ross Avenue
12th Floor, Suite 1200
Dallas, TX 75202-2733
214/665-2200,or
800/887-6063 in Region 6

EPA, REGION VII

Region 7
901 North 5th Street
Kansas City, KS 66101
913/551-7000, or
800/223-0425 in Region 7

EPA, REGION VIII

Region 8
One Denver Place
999 18th Street
Suite 500
Denver, CO 80202-2466
303/293-1603, or
800/227-8917 in Region 8

EPA, REGION IX

Region 9
75 Hawthorne St.
San Francisco, CA 94105
415/744-1305

EPA, REGION X

Region 10
1200 Sixth Avenue
Seattle, WA 98101
206/553-4973
800/424-4372

APPENDIX F
ALPHABETIC CROSS REFERENCE

CHEMICAL	GUIDE
Acetene	Ethylene
Acetic acid, anhydride	Acetic anhydride
Acetic acid, butyl ester	Butyl acetate
Acetic acid ethenyl ester	Vinyl acetate
Acetic acid ethylene ether	Vinyl acetate
Acetic acid, 2-ethoxyethyl ester	Ethylene glycol monoethyl ether acetate
Acetic acid, ethyl ester	Ethyl acetate
Acetic acid (aqueous)	Acetic acid
Acetic acid, isobutyl ester	Isobutyl acetate
Acetic acid, 2-methylpropyl ester	Isobutyl acetate
Acetic, popyl ester	Propyl acetate
Acetic acid vinyl ester	Vinyl acetate
Acetic aldehyde	Acetaldehyde
Acetic anhydride	Acetic anhydride
Acetic ester	Ethyl acetate
Acetic ether	Ethyl acetate
Acetonyl bromide	Bromoacetone
2-Acetooxy propane	Isopropyl acetate
Acetoxyethane	Vinyl acetate
1-Acetoxyethylene	Vinyl acetate
Acetoxyl	Benzoyl peroxide
1-Acetoxypropane	Propyl acetate
Acetyl ether	Acetic anhydride
Acetylene trichloride	Trichloroethylene
Acetylenogen	Calcium carbide
Acetyl methyl bromide	Bromoacetone
Acetyl oxide	Acetic anhydride
Acid oil of vitriol	Sulfuric acid
Acifloctin	Adipic acid
Acinetten	Adipic Acid
ACN	Acrylonitrile, stabilized
Acquinite	Chloropicrin
Acraldehyde	Acrolein
Acroleic acid	Acrylic acid
Acrylaldehyde	Acrolein
Acrylic acid, butyl ester	Butyl acrylate
Acrylic acid, ethyl ester	Ethyl acrylate
Acrylic acid, 2-ethylhexyl ester	2-Ethylhexyl acrylate
Acrylic acid, methyl ester	Methyl acrylate, inhibited
Acrylic aldehyde	Acrolein
Acrylic amide	Acrylamide
Acrylic resin monomer	Methyl methacrylate
Acrylon	Acrylonitrile
Acrylonitrile	Acrylonitrile
Acrylonitrile monomer	Acrylonitrile
Acrylonitrile, inhibited	Acrylonitrile
Adilactetten	Adipic acid
Adipic acid dinitrile	Adipic acid
Adipic acid nitrile	Adipic acid
Adipic nitrile	Adipic acid
Adipinicc acid	Adipic acid
ADN	Adiponitrile
Aethylis	Ethyl chloride
Aethylis chloridum	Ethyl chloride
AHF	Hydrogen fluoride
Albone	Hydrogen peroxide
Alborn	Hydrogen fluoride
Alcohol C-8	Octanol
Alcohol of sulfur	Carbon disulfide
Aldehyde	Octyl aldehydes
C-8 aldehyde	Octyl aldehydes
Aldehido C-8	Octyl aldehydes
Allyl aldehyde	Acrolein
Allylic alcohol	Allyl alcohol
Aluminum sodium oxide	Sodium aluminate
Aminic acid	Formic acid
Aminobenzene	Aniline oil
2.2-Aminodiethanol	Diethanolamine
Aminoethane	Ethylamine
2-Aminoethanol	Ethanolamine
Aminoethyl alcohol	Ethanolamine
beta-Aminoethyl alcohol	Ethanolamine
Aminoethylene	Ethyleneimine
Aminomethane	Methylamine, anhydrous or aqueous solution
Aminomethane, anhydrous	Methylamine, anhydrous or aqueous solution
1-Amino-2-nitrobenzene	ortho-Nitroaniline
2-Aminopentane	Diethylamine
Aminophen	Aniline oil
1-Aminopropane	Propylamine
2-Aminopropane	Isopropylamine
3-Aminopropane	Allylamine
2-Aminopropylene	Allylamine
3-Amino-p-toluidine	2,4-Toluylenediamine
5-Amino-p-toluidine	2,4-Toluylenediamine
Ammonia monohydrate	Ammonium hydroxide
Ammonium solution (containing 44% or less ammonia in water)	Ammonium hydroxide
Ammonium solution (containing more than 44% ammonia)	Anhydrous ammonium
Ammonia water	Ammonium hydroxide
Ammonium bisulfide	Ammonium sulfide solution
Ammonium hydrate	Ammonium hydroxide
Ammonium hydrogen sulfide	Ammonium sulfide solution
Ammonium hydrosulfide	Ammonium sulfide solution
Ammonium hydrosulphide	Ammonium sulfide solution
Ammonium mercaptan	Ammonium sulfide solution
Ammonium nitrate-carbonate mixture	Ammonium nitrate
Ammonium nitrate mixed fertilizers	Ammonium nitrate
Ammonium nitrate-phosphate	Ammonium nitrate
Ammonium sulfhydrate	Ammonium sulfide solution
Ammonium sulphide, solution	Ammonium sulfide solution
AMS	Isopropylbenzene
Amsco tetramer	Propylene tetramer

CHEMICAL	GUIDE
Amyl hydride	Pentane
6-Aminocaproic acid lactam	Caprolactam
Amino caproic lactam	Caprolactam
6-Aminohexanoic acid cyclic lactam	Caprolactam
AN	Acrylonitrile, stabilized
Anhydrol	Ethyl alcohol
Anhydrous ethanol	Ethyl alcohol
Anhydrous hydrobromic acid	Hydrogen bromide
Anhydrous hydrochloric acid	Hydrogen chloride
Anhydrous hydrofluoric acid	hydrogen fluoride
Anilin	Aniline oil
Aniline	Aniline oil
Aniline, 2-nitro	ortho-Nitroaniline
Annulene	Benzene
Antisal 1A	Toluene
Anodynon	Ethyl chloride
Anprolene	Ethylene oxide
Anthracene oil	Coal Tar
Antiknock compound	Motor fuel antiknock compound
Aqua ammonia	Ammonium hydroxide
Aqua fortis	Nitric acid, red fuming
Aqualin	Acrolein
Aqueous ammonia	Ammonium hydroxide
Aqueous HF	Hydrofluoric acid
Aqueous hydrogen chloride	Hydrochloric acid
Arsenic chlorice	Arsenic trichloride
Arsenic (III) oxide	Arsenic trioxide
Arsenic oxide	Arsenic trioxide
Arsenic sesquioxide	Arsenic trioxide
Arsenic (III) trichloride	Arsenic trichloride
Arsenic, white, solid	Arsenic trioxide
Arsenious acid, solid	Arsenic trichloride
Arsenious chloride	Arsenic trichloride
Arsenious oxide	Arsenic trioxide
Arsenite	Arsenic trioxide
Arsenolite	Arsenic trioxide
Arsenous acid	Arsenic trioxide
Arsenous acid anhydride	Arsenic trioxide
Arsenous anhydride	Arsenic trioxide
Arsenous chloride	Arsenic trichloride
Arsenous oxide	Arsenic trioxide
Arsodent	Arsenic trioxide
Asphaltum	Asphalt
Arabenzene	Pyridine
Azacyclopropane	Ethyleneimine
Automotive gasoline	Gasoline
Aviation gasoline	Gasoline
Azine	Pyridine
Aziran	Ethyleneimine
Azirane	Ethyleneimine
Aziridine	Ethyleneimine
Azogien developer h	2,4-Toluylenediamine
Azotic acid	Nitric acid, red fuming
Basilin	Hydrogen chloride
Battery acid	Sulfuric acid
Benoxyl	Benzoyl peroxide
Benzenamine	Aniline oil
Benzene chloride	Chlorobenzene
p-Benzenediol	Hydroquinone

CHEMICAL	GUIDE
1,4-Benzenediol	Hydroquinone
Benzene, 1-chloro-2-niro	ortho-Nitrochlorobenzene
Benzene, 1-chloro-3-niro	meta-Nitrochlorobenzene
Benzene, 1-chloro-4-niro	para-Nitrochlorobenzene
Benzene-p-dicarboxylic acid	Terephthalic acid
1,4-Benzenedicarboxylic acid	Terephthalic acid
p-Benzenedicarboxylicacid	Terephthalic acid
Benzene, 1,2-dichloro	o-Dichlorobenzene
Benzene hexahydride	Cyclohexane
1,2-Benzenedicarboxylic acid anhydride	Phthalic anhydride
1,2-Benzenedicarboxylic anhydride	Phthalic anhydride
Benzene-o-dicarboxylic acid anhydride	Phthalic anhydride
Benzene, nitro	Nitrobenzene
Benzene sulfonic acid, dodecyl Ester	Dodecylbenzenesulfonic acid
Benzenol	Carbolic acid or phenol
Benzin	Gasoline
Benzine	Petroleum distillates, n.o.s.
Benzinoform	Benzoyl peroxide
Benzohydroquinone	Hydroquinone
Benzoic acid peroxide	Carbon tetrachloride
Benzol	Benzene
Benzole	Benzene
Benzolene	Petroleum distillates, n.o.s.
Benzophenol	Carbolic acid or phenol
Benzoquinol	Hydroquinone
Benzoyl superoxide	Benzoyl peroxide
beta-Methyl acrolein	Crotonaldehyde
Bicarburretted hydrogen	Butadiene
Binitrotoluene	Dinitrotoluenes
Biocide	Acrolein
BIO-SOFT®	Alcohol ethoxylates
bis (2-Hydroxyethyl) amine	Diethanolamine
Bitumen	Asphalt
Bivinyl	Butadiene
Bleaching powder	Calcium hypochlorite
Blended gasoline	Gasoline
Blue oil	Aniline oil
Boroethane	Diborane
Boron chloride	Boron trichloride
Boron hydride	Diborane
Bottled gas	Petroleum gas, liquefied
BOV	Sulfuric acid
BP	Benzoyl peroxide
BPO	Benzoyl peroxide
Bromallyene	Allyl bromine
Bromoethane	Vinyl bromide
Bromoethylene	Vinyl bromide
Bromofume	Ethylene dibromide
Bromomethane	Methyl bromide
Brom-o-gas	Methyl bromide

CHEMICAL	GUIDE
1-Bromo-2-propanone	Bromoacetone
Bromo-2-propanone	Bromoacetone
3-Bromopropene	Allyl bromide
3-Bromo-1-propene	Allyl bromide
3-Bromopropylene	Allyl bromide
Bromosol	Methyl bromide
Brown oil	Sulfuric acid
Brozone	Methyl bromide
Bunker C	Fuel oil
alpha-Butadiene	Butadiene
Buta-1,3-diene	Butadiene
1,3-Butadiene	Butadiene
gamma-Butadiene	Butadiene
trans-Butadiene	Butadiene
Butal	Butyraldehyde
Butahyde	Butyraldehyde
Butane, 1-chloro	Chlorobutanes
Butan-2-one	Methyl ethyl ketone
Butanal	Butyraldehyde
n-Butanal	Butyraldehyde
n-Butane	Butane
Butane,1,4-epoxy	Tetrahydrofuran
1,4-Butanedicarboxylic acid	Adipic acid
Butanol	Butyl alcohol
Butanol acetate	Butyl acetate
sec-Butanol	Butyl alcohol
tert-Butanol	Butyl alcohol
1-Butanol	Butyl alcohol
2-Butanol	Butyl alcohol
Butanone	Methyl ethyl ketone
2-Butanone	Methyl ethyl ketone
2-Butenal	Crotonaldehyde
alpha-Butene	Butylene
Butene	Butylene
1-Butene	Butylene
cis-Butenedioic anhydride	Maleic anhydride
1,4-Butindiol	1,4-Butynediol
2-Butin-1,4-diol	1,4-Butynediol
2-Butoxy-1-ethanol	Ethylene glycol monobutyl ether
2-Butoxyethanol	Ethylene glycol monobutyl ether
Butter of arsenic	Arsenic trichloride
Butyl Cellosolve®	Ethylene glycol monobutyl ether
Butyl 2-propenoate	Butyl acrylate
n-Butyl acetate	Butyl acetate
n-Butyl acrylate	Butyl acrylate
sec-Butyl alcohol	Butyl alcohol
tert-Butyl alcohol	Butyl alcohol
Butyl aldehyde	Butyraldehyde
n-Butyl-1-butanamine	Butylamine
n-Butyl chloride	Chlorobutanes
Butyl ester	Butyl acetate
Butyl ethanoate	Butyl acetate
alpha-Butylene	Butylene
Butylene hydrate	Butyl alcohol
Butylene oxide	Tetrahydrofuran
Butyl ethylene	1-Hexene
Butyl hydride	Butane
Butylic ester	Butyl acetate
Butyi oxitol	Ethylene glycol monobutyl ether
2-Butyne-1,4-diol	1,4-Butynediol

CHEMICAL	GUIDE
2-Butynediol	1,4-Butynediol
Butynediol	1,4-Butynediol
Butynediol-1,4	1,4-Butynediol
Butyral	Butyraldehyde
Butyric alcohol	Butyl alcohol
Butyric aldehyde	Butyraldehyde
Calcium acetylide	Calcium carbide
Calcium dicarbide	Calcium carbide
Calcium chlorhydrochlorite	Calcium hypochlorite
Calcium hypochloride	Calcium hypochlorite
Calcium oxychloride	Calcium hypochlorite
Calcium salt	Calcium hypochlorite
Caliche	Sodium nitrate
Camphor tar	Naphthalene
Capryl alcohol	Octanol
Caprylaldehyde	Octyl aldehydes
Caprylene	1-Octene
Caprylic alcohol	Octanol
Caprylic aldehyde	Octyl aldehydes
Cabacryl	Acrylonitrile
Carbamide	Urea
Carbamimidic acid	Urea
Carbide	Calcium carbide
Carbide of calcium	Calcium carbide
Carbinamine	Methylamine, (anhydrous or aqueous solution)
Carbinamine, anhydrous	Methylamine, anhydrous
Carbinol	Methanol
Carbona	Carbon tetrachloride
Carbon bisulphide	Carbon disulfide
Carbon bisulphuret	Carbon disulfide
Carbon chloride	Carbon tetrachloride
Carbon disulphide	Carbon disulfide
Carbon fluoride oxide	Perchloryl fluoride
Carbon hydride nitride	Hydrocyanic acid
Carbonic acid dichloride	Phosgene
Carbonic acid gas	Carbon dioxide
Carbonic anhydride	Carbon dioxide
Carbonic dichloride	Phosgene
Carbonice	Carbon dioxide
Carbonic oxide	Carbon monoxide
Carbon nitride	Cyanogen
Carbonochloride acid, 1-methylethyl ester	Isopropyl chloroformate
Carbonochloridic acid, ethyl ester	Ethyl chloroformate
Carbonochloridic acid, methyl ester	Methyl chloroformate
Carbonochloride acid, 1-methylethyl	Isopropyl chloroformate
Carbon oxychloride	Phosgene
Carbon sulfide	Carbon bisulfide
Carbon tet	Carbon tetrachloride
Carbonyl chloride	Phosgene
Carbonyldiamide	Urea
Carbonyldiamine	Urea
Carboxyethane	Propionic acid

CHEMICAL	GUIDE
Cat cracker feedstock	Fuel oil
Casing head gasoline	Gasoline
Caustic arsenic chloride	Arsenic trichloride
Caustic oil of arsenic	Arsenic trichloride
Caustic potash	Potassium hydroxide or sodium hydroxide
Caustic potash, dry, solid, flake, bead, or granular	Potassium hydroxide
Caustic potash, liquid or solution	Potassium hydroxide or sodium hydroxide
Caustic soda (liquor, liquid or solution)	Sodium hydroxide
Celfume	Methyl bromide
Cellosolve	Ethylene glycol monoethyl ether
Cellosolve acetate	Ethylene glycol monoethyl ether
Celphos	Phosphine
Chelen	Ethyl chloride
Chamber acid	Sulfuric acid
Chile niter	Sodium nitrate
Chile nitrate	Sodium nitrate
Chile saltpeter	Sodium nitrate
Chloroacetic acid	Chloroacetic acid (solid or solution)
Chloroallylene	Allyl chloride
Chlorate of soda	Sodium chlorate
Chlorcyan	Cyanogen chloride
Chlorene	Ethyl chloride
1-Chlor-2,3-epoxypropane	Epichlorohydrin
Chloric acid, sodium salt	Sodium chlorate
Chloride of lime	Calcium hypochlorite
Chloride of phosphorus	Phosphorus trichloride
Chloride of sulfur	Sulfur chloride
Chloridum	Ethyl chloride
Chlorinated lime	Calcium hypochlorite
Chlorine cyanide	Cyanogen chloride
Chlorine oxyfluoride	Perchloryl fluoride
Chlorobenzol	Chlorobenzene
Chlorobutadiene	Chloroprene
1-Chlorobutadiene	Chloroprene
1-Chloro-1,3-butadiene	Chloroprene
1-Chlorobutane	Chlorobutanes
Chlorocyan	Cyanogen chloride
Chlorocyanide	Cyanogen chloride
Chlorocyanogen	Cyanogen chloride
1-Chloro-2,2-dichloroethylene	Trichloroethylene
Chlorodimethyl ether	Methylchloromethyl ether
3-Chloro-1,2-epoxypropane	Epichlorohydrin
Chloroethane	Ethyl chloride
Chloroethanoic acid	Chloroacetic acid (solid or solution)
Chloroethane	Vinyl chloride
Chloroethene	Vinyl chloride
Chloroethylene	Vinyl chloride
1-Chloroethylene	Vinyl chloride
Chloroformic aid, ethyl ester	Ethyl chloroformate
Chloroformic acid, isopropyl ester	Isopropyl chloroformate
Chloroformic aid, methyl ester	Methyl chloroformate
Chloroformyl chloride	Phosgene
Chlorohydric acid	Hydrogen chloride
Chloromethane	Methyl chloride
Chloromethoxymethane	Methylchloromethyl ether
Chloromethyl ethylene oxide	Epichlorohydrin
Chloromethylmethyl ether	Methylchloromethyl ether
Chloromethyloxirane	Epichlorohydrin
Chloronitrobenzenes	(meta, ortho, or para)-Nitrochlorobenzene
1,2-Chloronitrobenzene	ortho-Nitrochlorobenzene
1,3-Chloronitrobenzene	meta-Nitrochlorobenzene
1,4-Chloronitrobenzene	para-Nitrochlorobenzene
4-Chloronitrobenzene	para-Nitrochlorobenzene
m-Chloronitrobenzene	meta-Nitrochlorobenzene
o-Chloronitrobenzene	ortho-Nitrochlorobenzene
p-Chloronitrobenzene	para-Nitrochlorobenzene
1-Chloro-2-nitrobenzene	ortho-Nitrochlorobenzene
1-Chloro-3-nitrobenzene	meta-Nitrochlorobenzene
2-Chloro-1-nitrobenzene	ortho-Nitrochlorobenzene
4-Chloro-1-nitrobenzene	para-Nitrochlorobenzene
Chloro-m-nitrobenzene	meta-Nitrochlorobenzene
Chloro-o-nitrobenzene	ortho-Nitrochlorobenzene
Clor-O-Pic	Chloropicrin
Chloropicrin and methyl chloride mixture	Chloropicrin
Chloropicrin and methyl bromide mixture	Chloropicrin
beta-Chloroprene	Chloroprene
1-Chloropropene-2	Allyl chloride
1-Chloro-2-proprene	Allyl chloride
3-Chloroproprene	Allyl chloride
3-Chloro-2-proprene	Allyl chloride
3-Chloroproprene	Allyl chloride
3-Chloro-1-proprene	Allyl chloride
3-Chloroproprene-1	Allyl chloride
alpha-Chloropropylene	Allyl chloride
gamma-Chloropropylene oxide	Epichlorohydrin
2-Chloropropylene oxide	Epichlorohydrin
3-Chloro-1,2-propylene oxide	Epichlorohydrin
Chlorosulfuric acid	Chlorosulfonic acid
Chlorosulphonic acid	Chlorosulfonic acid
1-Chloro-1,2,2-trifluoroethylene	Trifluorochloroethylene, inhibited
Chlorotrifluoroethylene	Trifluorochloroethylene, inhibited
Chlorsulfonic acid	Chlorosulfonic acid
Chloryl	Ethyl chloride
Chloryl anesthetic	Ethyl chloride

CHEMICAL	GUIDE
Chromic acid, solid	Chromium trioxide, anhydrous
Chromic anhydride	Chromium trioxide, anhydrous
Chromic anhydride	Chromium trioxide, anhydrous
Chromium (VI) oxide	Chromium trioxide, anhydrous
C.I. 76035	2,4-Toluylenediamine
Cinnamene	Styrene monomer, stabilized
Cinnamenol	Styrene monomer, stabilized
Cinnamol	Styrene monomer, stabilized
Claudetite	Ethyl chloride
C.I. oxidation base	2,4-Toluylenediamine
C.I. oxidation base 20	2,4-Toluylenediamine
C.I. oxidation base 200	2,4-Toluylenediamine
C.I. oxidation base35	2,4-Toluylenediamine
Claudetite	Ethyl chloride
Cloretilo	Methylchloromethyl ether
CNME	Benzene
Coal naphtha	Kerosene
Coal oil	Petroleum crude oil
Coal tar creosote	Coal tar
Coal tar light oil	Petroleum distillates, n.o.s.
Coal tar naphtha	Coal tar
Coal tar oil	Coal tar distillates
Colamine	Ethanolamine
Colophony solution	Rosin solution
Columbia spirits	Methanol
Compressed petroleum gas	Petroleum gas, liquefied
Creosote oil	Coal tar
m-Cresol	Cresol
o-Cresol	Cresol
p-Cresol	Cresol
Cresole	Cresol
Cresylic acid	Cresol
Crolean	Acrolein
Crotonal	Crotonaldehyde, stabiloized
Crotonic aldehyde	Crotonaldehyde, stabiloized
Crude arsenic	Arsenic trioxide
Crude oil	Petroleum crude oil
CSA	Chlorosulfonic acid
Cubic niter	Sodium nitrate
Cumene	Isopropylbenzene
Cyanide of sodium	Sodium cyanide, solid
Cyanoethylene	Acrylonitrile
Cyclohexatriene	Benzene
Cyclohexyl ketone	Cyclohexanone
Cyclon	Hydrocyanic acid
1-3,-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	Hexachlorocyclopentadiene
Cyclotetramethylene oxide	Tetrahydrofuran
DBE	Ethylene dibromide
DCB	o-Dichlorobenzene
DCE	Vinylidene chloride
1,1-DCE	Vinylidene chloride
DCM	Dichloromethane
1,3-DCP	Propylene dichloride
DDBSA	Dodecylbenzenesulfonic acid
DEA	Diethanolamine
Deanol	2-Dimethylaminoethanol
De-fol-ate	Sodium chlorate
Developer 14	2,4-Toluylenediamine

CHEMICAL	GUIDE
Developer b	2,4-Toluylenediamine
Developer db	2,4-Toluylenediamine
Developer dbj	2,4-Toluylenediamine
Developer mc	2,4-Toluylenediamine
Developer mi	2,4-Toluylenediamine
Developer mt-mc	2,4-Toluylenediamine
Developer mtdj	2,4-Toluylenediamine
Developer t	2,4-Toluylenediamine
Deumabietis	Pine oil
Diamide	Hydrazine
Di (2-hydroxyethyl) amine	Diethanolamine
Diamine hydrate	Hydrazine
1,2-Diaminoethane	Ethylenediamine
1,6-Diaminohexane	Hexamethylene diamine solution
2,4-Diaminotoluene	2,4-Toluylenediamine
Diaminotoluene, 2,4-	2,4-Toluylenediamine
1,3-Diamino-4-methylbenzene	2,4-Toluylenediamine
2,4-Diamino-4-methylbenzene	2,4-Toluylenediamine
2,4-Diaminotoluol	2,4-Toluylenediamine
Diammonium sulfide	Ammonium sulfide solution
Diarsenic trioxide	Arsenic trioxide
Diarex HF 77	Styrene monomer, stabilized
Dibenzoyl peroxide	Benzoyl peroxide
Diboron hexahydride	Diborane
1,2-Dibromoethane	Ethylene dibromide
Dibutylamine	Butylamine
n-Dibutylamine	Butylamine
Di(n-butyl)amine	Butylamine
p-Dicarboxybenzene	Terephthalic acid
1,2-Dichlorobenzene	o-Dichlorobenzene
o-Dichlorobenzol	o-Dichlorobenzene
ortho-Dichlorobenzol	o-Dichlorobenzene
1,3-Dichloro-bix (2-chloroethyl) ether	Dichloropropene
1,1-dichloro-2-chloroethylene	Trichloroethylene
Dichlorodimethylsilane	Dimethyldichlorosilane
Dichlorodimethylsilicon	Dimethyldichlorosilane
1,1-Dichloroethane	Vinylidene chloride
1,1-Dichloroethylene	Vinylidene chloride
unsym-Dichloroethylene	Vinylidene chloride
Dichlorohydridomethylsilicon	Methyldichlorosilane
Dichloromethylsilane	Methyldichlorosilane
Dichloropropane	Propylene dichloride
1,3-Dichloropropene	Dichloropropene
Dichlorosilicane	Dichlorosilane
Dicyan	Cyanogen
1,4-Dicyanobuatane	Adiponitrile
Dicyanogen	Cyanogen
alpha-Dicyclopentadiene	Dicyclopentadiene
Diesel oil	Fuel oil
Diethyl	Butane
Diethylene oxide	Tetrahydrofuran
Diethylolamine	Diethanolamine
Difluorochloromethane	Chlorodifluoromethane
Difluoroethane	1,1-Difluoroethane
Difluoroethane, 1,1-	1,1-Difluoroethane
Difluoromonochloromethane	Chlorodifluoromethane

CHEMICAL	GUIDE
Dihydroazirene	Ethyleneimine, inhibited
Dihydroazirine	Ethyleneimine, inhibited
Dihydro-1H-azirine	Ethyleneimine, inhibited
Dihydro-2,5-dioxofuran	Maleic anhydride
1,3-Dihydro-1,3-dioxoisobenzofuran	Phthalic anhydride
Dihydrogen dioxide	Hydrogen peroxide
Dihydrogen monosulfide	Hydrogen sulfide
Dihydrogen selenide	Hydrogen selenide
Dihydrogen sulfide	Hydrogen sulfide
Dihydrooxirene	Ethylene oxide
1,4-Dihydroxy-2-butyne	1,4-Butynediol
Dihydroxybenzene	Hydroquinone
2,2-Dihydroxydiethylamine	Diethanolamine
1,2-Dihydroxyethane	Ethylene glycol
B,B-Dihydroxyethylamine	Diethanolamine
Diisobutene	Diisobutylene
alpha-Diisobutylene	Diisobutylene
beta-Diisobutylene	Diisobutylene
1,3-diisocyanatomethylbenzene	Toluene diisocyanate
Diisocyanatotoluene	Toluene diisocyanate
Diisopropyl oxide	Diisopropyl ether
n,n-Dimethyl	N,N-Dimethylformamide
Dimethylaminoethanol	2-Dimethylaminoethanol
beta-Dimethylaminethyl alcohol	2-Dimethylaminoethanol
1,2-Dimethylbenzene	Xylene
1,3-Dimethylbenzene	Xylene
1,4-Dimethylbenzene	Xylene
Dimethyl-13C2 ether (gas)	Dimethyl ether
Dimethylcarbinol	Isopropanol
Dimethylchloroether	Methylchloromethyl ether
Dimethylene oxide	Ethylene oxide
Dimethyleneimine	Ethyleneimine, inhibited
Dimethyleimine	Ethyleneimine, inhibited
Dimethylethanolamine	2-Dimethylaminoethanol
1,1-Dimethylethane	Isobutane
N,N-Dimethyl-N-ethanolamine	2-Dimethylaminoethanol
N-N,Dimethylethanolamine	2-Dimethylaminoethanol
Dimethyl formaldehyde	Acetone
Dimethyl formamide	N,N-Dimethylformamide
N,N-Dimethyl-2-hydroxyethyl amine	2-Dimethylaminoethanol
N,N-Dimethyl-N-(2-hydroxyethyl) amine	2-Dimethylaminoethanol
Dimethyl ketal	Acetone
Dimethyl ketone	Acetone
n,n-Dimethyl methylamine	Trimethylamine
Dimethyl monosulfate	Dimethyl sulfate
Dinitrophenylmethane	Dinitrotoluenes
Dinitrogen monoxide	Nitrous oxide
Dinitrogen oxide	Nitrous oxide
2,4-Dinitrotoluenes	Dinitrotoluenes
2,6-Dinitrotoluenes	Dinitrotoluenes
Dinitrotoluol	Dinitrotoluenes
1,3-Dioxophthalan	Phthalic anhydride
Diphenylmethane diisocyanate	Methylene diphenyl diisocyanate
Diphosgene	Phosgene
Dipping acid	Sulfuric acid
Dipropylamine	Di-n-propylamine
n-Dipropylamine	Di-n-propylamine

CHEMICAL	GUIDE
Dipropylmethane	Heptane
Disulfur dichloride	Sulfur chloride
Disulphuric acid	Oleum
Dithiocarbonic anhydride	Carbon bisulfide
Dithionic acid	Sulfuric acid
Dithionite, hyposulfite	Sodium hydrosulfite
Divinylene oxide	Furan
Divinyl, inhibited	Butadiene
DMA	Dimethylamine, anhydrous
DMAE	2-Dimethylaminoethanol
DMF	N,N-Dimethylformamide
DMF (amide)	N,N-Dimethylformamide
DMFA	N,N-Dimethylformamide
DMS	Dimethyl sulfate
DNPA	Di-n-propylamine
DNT	Dinitrotoluenes
Dodecene	Propylene tetramer
Dodecylene	Propylene tetramer
Dolochor	Chloropicrin
Dowanol® EB	Ethylene glycol monobutyl ether
Dowanol 33b	1-Methoxy-2-propanol
Dowanol pm	1-Methoxy-2-propanol
Dowtherm 209	1-Methoxy-2-propanol
Dry ice	Carbon dioxide
Dublofix	Ethyl chloride
Dytol M-83	Octanol
E6	Ethylene glycol
EA	Ethylamine
ECH	Epichlorohydrin
EDB	Ethylene dibromide
Edco	Methyl bromide
EGBE	Ethylene glycol monobutyl ether
EHA	2-Ethylhexylacrylate
Ektasolve EB®	Ethylene glycol monobutyl ether
Ektasolve EE®	Ethylene glycol monoethyl ether
Ektasolve EE acetate	Ethylene glycol monoethyl ether
Elayl	Ethylene
Eldopaque	Hydroquinone
Eldoquin	Hydroquinone
Electro-CF12	Dichlorodifluoromethane
Electro-CF22	Chlorodifluoromethane
Elemental phosphorus	Phosphorus, white or yellow
Embafume	Methyl bromide
Emkanol	Ethylene glycol monoethyl ether
EO	Ethylene oxide
EPI	Epichlorohydrin
alpha-Epichlorohydrin	Epichlorohydrin

CHEMICAL	GUIDE
2,3-Epoxpropyl chloride	Epichlorohydrin
1,2-Epoxy -3-chlorpropane	Epichlorohydrin
Epoxyethane	Ethylene oxide
1,2 Epoxyethane	Ethylene oxide
Epoxy propane	Propylene oxide
1,2-Epoxypropane	Propylene oxide
Essence of mirbane	Nitrobenzene
Essence of myrbane	Nitrobenzene
EtO	Ethylene oxide
Ethanal	Acetaldehyde
Ethane carboxylic acid	Propionic acid
Ethanedinitrile	Cyanogen
1,2-Ethanediol	Ethylene glycol
Ethanediol	Ethylene glycol
1,2-Ethanediol, dipropanoate	Crotonaldehyde, stabilized
Ethanethiol	Ethyl mercaptan
Ethanoic acid	Acetic acid
Ethanoic anhydride	Acetic anhydride
Ethanol	Ethyl alcohol
Ethanolamine	Ethanolamine
Beta-Ethanolamine	Ethanolamine
Ethene	Ethylene
Ethene, bromo	Vinyl bromide
Etheneoxide	Ethylene oxide
Ethenylbenzene	Styrene monomer, inhibited
Ethenyl ethanoate	Vinyl acetate
Ether	Diethyl ether
Ether chloratus	Ethyl chloride
Etherin	Ethylene
Ethinyl trichloride	Trichloroethylene
Ethirydine	Ethyleneimine, inhibited
Ethoxy acetate	Ethylene glycol monoethyl ether acetate
Ethoxyethane	Diethyl ether
2-Ethoxyethanol	Ethylene glycol monoethyl ether
2-Ethoxyethanol acetate	Ethylene glycol monoethyl ether acetate
Ethoxyethyl acetate	Ethylene glycol monoethyl ether acetate
2-Ethoxyethyl acetate	Ethylene glycol monoethyl ether acetate
beta-Ethoxyethyl acetate	Ethylene glycol monoethyl ether acetate
Ethoxylated alcohols	Alcohol ethoxylates
Ethyl aldehyde	Acetaldehyde
Ethyl alpha-methylacrylate	Ethyl methacrylate
Ethyl benzol	Ethyl benzene
Ethyl cellosolve	Ethylene glycol monoethyl ether
Ethyl clorocarbonate	Ethyl chloroformate
Ethyldimethylmethane	Isopentane
Ethylenyl acetate	Vinyl acetate
Ethylene aldehyde	Acrolein
Ethylene carboxamide	Acrylamide
Ethylene carboxylic acid	Acrylic acid, stabilized
Ethylene dihydrate	Ethylene glycol
Ethylene dipropionate	Crotonaldehyde, stabilized
Ethylene fluoride	1,1-Difluoroethane
Ethylene glycol, dipropionate	Crotonaldehyde
Ethylene glycol ethyl ether	Ethylene glycol monoethyl ether
Ethylene monochloride	Vinyl chloride

CHEMICAL	GUIDE
Ethylene propionate	Crotonaldehyde, stabilized
Ethylene trichloride	Trichloroethylene
n-Ethylethanamine	Diethylamine
Ethyl ethanoate, acetic ester	Ethyl acetate
Ethyl ether	Diethyl ether
Ethylethylene	Butylene
Ethyl fluid	Motor fuel antiknock compound
Ethylformic acid	Propionic acid
Ethyl glycol acetate	Ethylene glycol monoethyl ether acetate
2-Ethyl hexanol	Octanol
2-Ethyl-hexyl alcohol	Octanol
2-Ethylhexyl-2-propenoate	2-Ethylhexyl acrylate
Ethyl hydrate	Ethyl alcohol
Ethyl hydrosulfide	Ethyl mercaptan
Ethyl hydroxide	Ethyl alcohol
Ethylic acid	Acetic acid
Ethyidene difluoride	1,1-Difluoroethane
Ethyidene fluoride	1,1-Difluoroethane
Ethyl-2-methcrylate	Ethyl methacrylate
Ethyl methyl acrylate	Ethyl methacrylate
Ethyl 2-methyl-2-propenoate	Ethyl methacrylate
Ethylolamine	Ethanolamine
Ethyloxide	Ethylene oxide
Ethyl propenoate	Ethyl acrylate
Ethyl 2-propenoate	Ethyl acrylate
Ethyl sulfhydrate	Ethyl mercaptan
Ethyl thioalcohol	Ethyl mercaptan
Ethyne, calcium derivative	Calcium carbide
ETN	Ethylamine
EtOH	Ethyl alcohol
Eucanine gb	2,4-Toluylenediamine
2-Furancarbinol	Furfuryl alcohol
Factitious air	Nitrous oxide
Fannoform	Formaldehyde solution
Fasciolin	Carbon tetrachloride
FC-12	Dichlorodifluoromethane
FC-22	Chlorodifluoromethane
Fermenicide liquid or powder	Sulfur dioxide
Fermentation alcohol	Ethyl alcohol
Ferric perchloride, solution	Ferric chloride, solution
Fertilizer acid	Sulfuric acid
Filmcol	Ethyl alcohol
Flukoids	Carbon tetrachloride
Fluohydric acid	Hydrofluoric acid
Fluorhydric acid	Hydrofluoric acid
Fluoric acid	Hydrofluoric acid
Fluorocarbon-12	Dichlorodifluoromethane
Fluorocarbon-152a	1,1-Difluoroethane
Fluorohydric acid	Hydrogen fluoride
Fluoromethane	Methyl fluoride

CHEMICAL	GUIDE
Fluorosilicic acid	Hydrofluorosilicic acid
Fluosilicic acid	Hydrofluorosilicic acid
Formacel®	1,1,1,2-Tetrafluoroethane
Formalin	Formaldehyde solution
Formalith	Formaldehyde solution
Formamide	N,N-Dimethylformamide
Formic acid, amide	N,N-Dimethylformamide
Formic aldehyde	Formaldehyde solution
Formic anammonide	Hydrocyanic acid
Formonitrile	Hydrocyanic acid
n-Formyldimethylamine	N,N-Dimethylforma-mide
Formylic acid	Formic acid
Formyl trichloride	Chloroform
Fouramine	2,4-Toluylenediamine
Fouramine j	2,4-Toluylenediamine
Fouramine 94	2,4-Toluylenediamine
Fouramine m	2,4-Toluylenediamine
Freon 10	Carbon tetrachloride
Freon 12	Dichlorodifluoromethane
Freon 20	Chloroform
Freon 22	Chlorodifluoromethane
Freon 30	Dichloromethane
Freon 40	Methyl chloride
Freon 143a	1,1,1-Trifluoroethane
Freon 152a	1,1-Difluoroethane
Freon F-12	Dichlorodifluoromethane
Frigen 12	Dichlorodifluoromethane
Fuel oil no. 1	Kerosene
Fuel oil no. 2	Fuel oil
Fuel oil no. 4	Fuel oil
Fuel oil no. 5	Fuel oil
Fuel oil no. 6	Fuel oil
Fumigant-1	Methyl bromide
Fumigrain	Acrylonitrile
Fuming liquid arsenic	Arsenic trichloride
Fuming sulfuric acid	Oleum
Fuming sulphuric acid	Oleum
Fumo-gas	Ethylene dibromide
2,5-Furandione	Maleic anhydride
Furanidine	Tetrahydrofuran
2-Furanmethanol	Furfuryl alcohol
Furfuralcohol	Furfuryl alcohol
Furfural alcohol	Furfuryl alcohol
Furfuran	Furan
Furyl alcohol	Furfuryl alcohol
2-Furylcarbinol	Furfuryl alcohol
alpha-Furylcarbinol	Furfuryl alcohol
Fyde	Formaldehyde solution
GAA	Phosphine
Genetron 100	1,1-Difluoroethane
Genetron 12	Dichlorodifluoromethane
Genetron 22	Chlorodifluoromethane
Genetron 152a	1,1-Difluoroethane
Glacial acetic acid	Acetic acid
Glacial acrylic acid	Acrylic acid, stabilized
Getlysolve C	Heptane
Glycerol epichlorohydrin	Epichlorohydrin
Glycidyl chloride	Epichlorohydrin
Glycinol	Ethanolamine
Glycol	Ethylene glycol
Glycol alcohol	Ethylene glycol
Glycol bromide	Ethylene dibromide
Glycol dibromide	Ethylene dibromide
Glycol ether EE acetate	Ethylene glycol monoethyl ether acetate
Glycol ether pm	1-Methoxy -2-propanol
Glycol monoethyl ether	Ethylene glycol monoethyl ether
Glycol monoethyl ether acetate	Ethylene glycol monoethyl ether acetate
Grain alcohol	Ethyl alcohol
Halocarbon-12	Dichlorodifluoromethane
Halocarbon 134A	1,1,1,2-Tetrachloroethane
Halon 104	Carbon tetrachloride
Halon 122	Dichlorodifluoromethane
Halon 1001	Methyl bromide
Halon 1220	Dichlorodifluoromethane
HCCPD	Hexachlorocyclopentadiene
HCN	Hydrocyanic acid
HE-5	Hydroquinone
Hemiterpene	Isoprene
Heptyl carbinol	Octanol
Heptyl hydride	Heptane
Hexachloro-1,3-cyclopentadiene	Hexachlorocyclopentadiene
1,1,1,3,3,3-Hexafluoro-2-propanone	Hexafluoroacetone
Hexahydrobenzene	Cyclohexane
Hexamethylene	Cyclohexane
Hexanaphthene	Cyclohexane
n-Hexane	Hexane
1,6-Hexanediamine	Hexamethylene diamine solution
Hexanedinitrile	Adiponitrile
Hexanedioc acid	Adipic acid
Hexanedioic acid dinitrile	Adiponitrile
1,6-Hexanedioc acid	Adipic acid
1-Hexanol,2-ethyl-, acrylate	2-Ethylhexyl acrylate
Hexanon	Cyclohexanone
Hexene	1-Hexene
Hex-1-ene	1-Hexene
Hexone	Methyl isobutyl ketone
sec-Hexyl alcohol	Methyl isobutyl carbinol
Hexylene	1-Hexene
Hexyl hydride	Hexane
HF	Hydrogen fluoride
HF-A	Hydrogen fluoride
HFA	Hexafluoroacetone
HFC-134a	1,1,1,2-Tetrachloroethane
Hioxy	Hydrogen peroxide
HMDA	Hexamethylene diamine solution

CHEMICAL	GUIDE
Home heating oil	Fuel oil
HTH	Calcium hypochlorite
Hydrazine hydrate	Hydrazine
Hydrazomethane	Methyl hydrazine
Hydrobromic acid, anhydrous	Hydrogen bromide
Hydrochloric acid, anhydrous	Hydrogen chloride
Hydrochloric ether	Ethyl chloride
Hydrochloride	Hydrogen chloride
Hydrocyanic acid, sodium salt	Sodium cyanide, solid
Hydrofluoric acid, anhydrous	Hydrogen fluoride
Hydrofluorosilicic acid	Hydrofluorosilicic acid
Hydrofuran	Tetrahydrofuran
Hydrogen carboxylic acid	Formic acid
Hydrogen chloride, solution	Hydrochloric acid
Hydrogen cyanide	Hydrocyanic acid
Hydrogen dioxide	Hydrogen peroxide
Hydrogen fluoride aqueous solution	Hydrofluoric acid
Hydrogen hexafluorosilicate	Hydrofluorosilicic acid
Hydrogen nitrate	Nitric acid, red fuming
Hydrogen oxide	Hydrogen peroxide
Hydrogen phosphide	Phosphine
Hydrogen phosphate solution	Phosphoric acid
Hydrogen sulphide	Hydrogen sulfide
Hydroperoxide	Hydrogen peroxide
Hydroquinol	Hydroquinone
Hydrosilicofluoric acid	Hydrofluorosilicic acid
Hydrosulfite of soda	Sodium hydrosulfite
Hydrosulfuric acid	Hydrogen sulfide
Hydroxybenzene	Carbolic acid or phenol
Hydroxy biacetyl	Acetic anhydride
1-Hydroxybutane	Butyl alcohol
2-Hydroxybutane	Butyl alcohol
2-Hydroxyethanol	Ethylene glycol
Hydroxyether	Ethylene glycol monoethyl ether
2-Hydroxyethylamine	Ethanolamine
beta-Hydroxyethylamine	Ethanolamine
beta-Hydroxyethyldimethylamine	2-Dimethylaminoethanol
alpha-Hydroxyisobutyronitrile	Acetone cyanohydrin, stabilized
bis(Hydroxymethyl) acetylene	1,4-Butynediol
1-Hydroxy -2-methylbenzene	Cresol
1-Hydroxy -3-methylbenzene	Cresol
1-Hydroxy -6-methylbenzene	Cresol
2-Hydroxymethyl furan	Furfuryl alcohol
2-Hydroxy -2-methylpropanenitrile	Acetone cyanohydrin, stabilized
2-Hydroxy -2-methylpropionitrile	Acetone cyanohydrin, stabilized
4-Hydroxyphenol	Hydroquinone
Hydroxy phenol	Hydroquinone
Hydroxypropene	Allyl alcohol
Hydroxytoluene	Cresol
Hyfluoric acid	Hydrofluoric acid
Hylene T	Toluene diisocyanate
Hypochlorous acid	Calcium hypochlorite
Hyponitrous acid anhydride	Nitrous oxide
2,2-Iminobisethanol	Diethanolamine
2,2-Iminodiethanol	Diethanolamine
Incidol	Benzoyl peroxide
Inerton DW-DMC	Dimethyldichlorosilane
Inhibine	Hydrogen peroxide
IPA	Isopropanol
Iron chloride	Ferric chloride solution
Iron (2+) chloride	Ferrous chloride solution
Iron (II) chloride	Ferrous chloride solution
Iron (III) chloride	Ferric chloride solution
Iron dichloride	Ferrous chloride solution
Iron muriate	Ferric chloride solution
Iron pechloride, chloride	Ferric chloride solution
Iron trichloride	Ferric chloride solution
Isceon 12	Dichlorodifluoromethane
Iscobrome	Methyl bromide
Iscobrome D	Ethylene dibromide
Isoamylhydride	Isopentane
1,3-Isobenzofurandione	Phthalic anhydride
Isobutanal	Isobutyraldehyde
Isobutyl methyl ketone	Methyl isobutyl ketone
Isobutyric aldehyde	Isobutyraldehyde
Isocyanatomethane	Methyl isocyanate
Isocyanic acid methyl ester	Methyl isocyanate
Isocyanic acid, methyl-m-phenylene ester	Toluene diisocyanate
Isocyanic acid, methylphenylene ester	Toluene diisocyanate
Isopentadiene	Isoprene
2-Isopropoxy propane	Diisopropyl ether
Isopropyl acetone	Methyl isobutyl ketone
Isopropyl alcohol	Isopropanol
Isopropyl chlorocarbonate	Isopropyl chloroformate
Isopropyl chloroformate	Isopropyl chloroformate
Isopropyl chloromethanoate	Isopropyl chloroformate
Isopropylcyanohydrin	Acetone cyanohydrin, stabilized
Isopropyl ester	Isopropyl acetate
Isopropyl ether	Diisopropyl ether
Isopropyl formaldehyde	Isobutyraldehyde
Isotron 12	Dichlorodifluoromethane
Isotron 22	Chlorodifluoromethane
Isourea	Urea
Ivalon	Formaldehyde solution
Jaysol S	Ethyl alcohol
Jefferssol	Ethylene glycol monobutyl ether
JP-1	Kerosene
Judean pitch	Asphalt
KOH	Potassium hydroxide
Kayafume	Methyl bromide
Kelene	Ethyl chloride
Ketohexamethylene	Cyclohexanone
Ketone propane	Acetone
beta-Ketopropane	Acetone
Klorex	Sodium chlorate
Kopfume	Ethylene dibromide
Kresol	Cresol
K-stoff, ester	Methyl Chloroformate

CHEMICAL	GUIDE
Kusatol	Sodium chlorate
Kyanol	Aniline oil
Larvacide	Chloropicrin
Laughing gas	Nitrous oxide
Laurylbenzenesulfonic acid	Dodecylbenzenesulfonic acid
Lead tetraethyl	Motor fuel antiknock compound
Lead tetramethyl	Motor fuel antiknock compound
Ledon 12	Dichlorodifluoromethane
Light gasoline	Gasoline
Light ligroin	Petroleum distillates, n.o.s.
Ligroin	Petroleum distillates, n.o.s.
Lime chloride	Calcium hypochlorite
Liquefied hydrocarbon gas	Petroleum gas, liquefied
Liquid pitch	Coal tar
LNG	Liquefied natural gas
Lorol 20	Octanol
LOX	Oxygen
LPG	Petroleum gas, liquefied
Lucidol	Benzoyl peroxide
Lye	Sodium hydroxide or potassium hydroxide
Lysoform	Formaldehyde solution
Lythene	Petroleum distillates, n.o.s.
Magnicide H	Acrolein
Maleic acid anhydride	Maleic anhydride
MB	Methyl bromide
M-B-C fumigant MEGR	Methyl bromide
MBX	Methyl bromide
MCA	Chloroacetic acid, (solid or solution)
MCB	Chlorobenzene
MDI	Methylene diphenyl diisocyanate
MEG	Ethylene glycol
MEA	Ethanolamine
MEK	Methyl ethyl ketone
Mercaptoethane	Ethyl mercaptan
Mercaptomethane	Methyl mercaptan
Mercurialin	Methylamine, (anhydrous or aqueous solution)
Mercurialin, anhydrous	Methylamine, anhydrous
Metacetonic acid	Propionic acid
Metafume	Methyl bromide
Metallic sodium	Sodium (metal)
Methacide	Toluene
alpha-Methacrylic acid	Methacrylic acid, inhibited
Methacrylic acid, ethyl ester	Ethyl methacrylate
Methacrylic acid, methyl ester	Methyl methacrylate
Methanal	Formaldehyde solution
Methanamine	Methylamine, (anhydrous or aqueous solution)
Methanamine, anhydrous	Methylamine, anhydrous
Methanamine, n,n-dimethyl	Trimethylamine
Methane carboxylic acid	Acetic acid
Methane dichloride	Dichloromethane
Methane, refrigerated liquid	Liquefied natural gas
Methane tetrachloride	Carbon tetrachloride
Methanethiol	Methyl mercaptan
Methanoic acid	Formic acid
Methionol	4-Thiapentanal
Methogas	Methyl bromide

CHEMICAL	GUIDE
Methoxycarbonyl chloride	Methyl chloroformate
Methoxychloromethane	Methylchloromethyl ether
Methoxy ether of propylene glycol	1-Methoxy -2-propanol
1-Methoxy -2-hydroxypropane	1-Methoxy -2-propanol
1-Methoxy -2-propanol	1-Methoxy -2-propanol
1-Methoxypropan-2-ol	1-Methoxy -2-propanol
Methyoxymethane	Dimethyl ether
Methoxymethylchloride	Methylchloromethyl ether
Methoxypropanol, alpha isomer	1-Methoxy -2-propanol
Methyl acetaldehyde	Propionaldehyde
Methyl acetic acid	Propionic acid
Methyl acetone	Methyl ethyl ketone
Methyl alcohol	Methanol
Methylaldehyde	Formaldehyde solution
Methyl-alpha-methylacrylate	Methyl methacrylate
Methylamy a;cpjp;	Methyl isobutyl carbinol
Methylated spirit	Ethyl alcohol
Methyazacyclopropane	Propyleneimine
2-Methylaziridine	Propyleneimine
Methylbenzene	Toluene
4-Methy-1,3-benzenediamine	2,4-Toluylenediamine
Methylbenzol	Toluene
beta-Methylbivinyl	Isoprene
2-Methyl-1,3-butadiene	Isoprene
3-Methyl-1,3-butadiene	Isoprene
2-Methylbutadiene	Isoprene
Methlcarbamodithoic acid	Metam sodium
Methylcarbinol	Ethyl alcohol
Methyl carbonmide	Methyl isocyanate
Methylcarbylamine	Methyl isocyanate
Methyl chloroform	1,1,1-Trichloroethane
Methyldithiocarbamate	Metam sodium
1-Methyl-2,4-Dinitrobenzene	Dinitrotoluenes
1-Methyl-2,6-Dinitrobenzene	Dinitrotoluenes
Methyldinitrobenzene	Dinitrotoluenes
Methylene bichloride	Dichloromethane
Methylene bisphenyl isocyanate	Methylene diphenyl diisocyanate
Methylene dichloride	Dichloromethane
Methylene di-p-phenylene	Methylene diphenyl diisocyanate
Methylene oxide	Formaldehyde solution
4,4-Methylene diphenyl diisocyanate	Methylene diphenyl diisocyanate
Methyl ester	Methyl isocyanate
Methyl ether	Dimethyl ether
Methylethylcarbinol	Butyl alcohol
(1-Methylethene) benzene	Isopropylbenzene
n-(1-Methylethyl)	Diisopropylamine
1-Methylethyl alcohol	Isopropanol
1-Methylethylamine	Isopropylamine
1-Methylethyl ester	Isopropyl acetate
Methylethyleneimine	Propyleneimine
1-Methylethyleneimine	Propyleneimine
2-Methylethyleneimine	Propyleneimine
Methylethylene oxide	Propylene oxide

CHEMICAL	GUIDE
Methylethylmethane	Butane
n-(Methylethyl)-2-propanamine	Diisopropylamine
Methylfluoroform	1,1,1-Trifluoroethane
6-Methyl-1-hepptanol	Isooctyl alcohol
1-Methylhydrazine	Methylhydrazine
Methyl hydroxide	Methanol
Methyl ketone	Acetone
2-Methyl laconirile	Acetone cyanohydrin, stablilized
Methylmercaptopropionaldehyde	4-Thiapentanal
3-(Methylmercapto) propionaldehyde	4-Thiapentanal
beta-(Methylmercapto) propionaldehyde	4-Thiapentanal
n-Methylmethanamine	Dimethylamine, anhydrous
Methyl 2-methyl-2-propenoate	Methyl methacrylate
Methyl methanoate	Methyl formate
Methyl oxide	Dimethyl ether
2-Methyl-4-pentanol	Methyl isobutyl carbinol
4-Methyl-2-pentanol	Methyl isobutyl carbinol
4-Methylpentanol-2	Methyl isobutyl carbinol
4-Methylpentan-2-ol	Methyl isobutyl carbinol
Methyl-2-pentanol	Methyl isobutyl carbinol
Methylpentanol	Methyl isobutyl carbinol
Methylol	Methanol
Methyl o-silicate	Methyl orthosilicate
Methyl oxirane	Propylene oxide
4-methyl-2-oxopentane	Methyl isobutyl ketone
2-methyl-4-oxotanone	Methyl isobutyl ketone
4-methyl-2-pentanone	Methyl isobutyl ketone
Methyl phenol	Cresol
4-Methyl-m-phenylenediamine	2,4-Toluylenediamine
4-Methylphenylene-1,3-diamine	2,4-Toluylenediamine
Methyl phenylene isocyanate	Toluene diisocyanate
Methyl phenylethene	Isopropylbenzene
2-Methyl-1-propanal	Isobutyraldehyde
3-Methylpropanal	Isobutyraldehyde
2-Methylpropane	Isobutane
iso-Methylpropane	Isobutane
2-Methyl-2-propanol	Butyl alcohol
2-Methyl propenal	Isobutyraldehyde
2-Methylpropenoic acid	Methyl methacrylate
2-Methyl-2-propenoic acid, ethyl ester	Ethyl methacrylate
alpha-Methylpropionaldehyde	Isobutyraldehyde
2-Methylpropionaldehyde	Isobutyraldehyde
2-Methylpropyl acetate	Isobutyl acetate
2-Methyl-1-propyl acetate	Isobutyl acetate
beta-Methylpropyl acetate	Isobutyl acetate
Methyl silicate	Methyl orthosilicate
Methylsilicon trichloride	Methyltriclorosilane
Methylsilyl trichloride	Methyltriclorosilane
alpha-Methyl styrene	Isopropenylbenzene
Methylsulfhyrate	Methyl mercaptan
Methylthioalcohol	Methyl mercaptan
Methyltrichloromethane	1,1,1-Trichloroethane
3-(Methylthio) propanol	4-Thiapentanal
3-(Methylthio) propionaldehyde	4-Thiapentanal
beta-(Methylthio) propionaldehyde	4-Thiapentanal
MIBC	Methyl isobutyl carbinol
MIBK	Methyl isobutyl ketone

CHEMICAL	GUIDE
Mibrane oil	Nitrobenzene
MIC	Methyl isocyanate
Microlysin	Chloropicrin
MIK	Methyl isobutyl ketone
Millers fumigrain	Acrylonitrile
Mineral Oil	Petroleum crude oil
Mineral pitch	Asphalt
MMH	Methyl hydrazine
MMP	4-Thiapentanal
Mondur 577	Methylene diphenyl diisocyanate
Mondur TDS	Toluene diisocyanate
Monoallylamine	Allylamine
Monobromoethylene	Vinyl bromide
Monobromomethane	Methyl bromide
Monochloroacetic acid	Chloroacetic acid, (solid or solution)
Monochlorethane	Ethyl chloride
Monochlorobenzene	Chlorobenzene
Monochloroethane	Ethyl chloride
Monochloroethene	Ethyl chloride
Monochloroethanoic acid	Chloroacetic acid, (solid or solution)
Monochloroethylene	Vinyl chloride
Monochloromethane	Methyl chloride
Monoethylene glycol	Ethylene glycol
Monohydroxymethane	Methanol
Monohydroxybenzene	Carbolic acid or phenol
Monoisopropylamine	Isopropylamine
Monomethylamine	Methylamine, (anhydrous or aqueous solution)
Monomethylamine, aqueous	Methylamine, (anhydrous or aqueous solution)
Monomethyl hydrazine	Methylhydrazine
Monomethyltriclorosilane	Methyltriclorosilane
Mononitrogen monoxide	Nitric oxide
Monovinyl chloride	Vinyl chloride
Moricid	Formaldehyde solution
Moth balls or flakes	Naphthalene
Motor fuel	Gasoline
Motor spirit	Gasoline
MTD	2,4-Toluylenediamine
Muriatic acid	Hydrochloric acid
Muriatic ether	Ethyl chloride
MVC	Vinyl chloride
Nacconate 100	Toluene diisocyanate
Nadone	Cyclohexanone
Nako-tmt	2,4-Toluylenediamine
Naphtha	Petroleum distillates, n.o.s.
Naphtha, coal tar	Petroleum distillates, n.o.s.
Naphthalene oil	Coal tar distillates
Naphthalin	Naphthalene
Naphthene	Naphthalene
Narcotile	Ethyl chloride
Natrium	Sodium (metal)
Natural gasoline	Gasoline

CHEMICAL	GUIDE
Natural gas, refrigerated liquid	Liquefied natural gas
Necatorina	Carbon tetrachloride
Necatorine	Carbon tetrachloride
NEODOL®	Alcohol ethoxylates
Neosol	Ethyl alcohol
Nephis	Ethylene dibromide
Nickel tetracarbonyl	Nickel carbonyl
Nital	Nitric acid, red fuming
Niter	Potassium nitrate
Nitratine	Sodium nitrate
Nitre	Potassium nitrate
Nitric acid, potassium salt	Potassium nitrate
Nitric acid, red fuming	Nitric acid, red fuming
Nitric-sulfuric acid mixtures	Nitrating acid
Nitriloacetontrile	Cyanogen
Nitroaniline	ortho-Nitroaniline
2-Nitroaniline	ortho-Nitroaniline
o-Nitroaniline	ortho-Nitroaniline
Nitroanilines	ortho-Nitroaniline
Nitro-sil	Anhydrous ammonia
Nitrobenzol	Nitrobenzene
(o-, m-, p-) Nitrochlorobenzene	(ortho, meta, para) Nitrochlorobenzene
Nitrochloroform	Chloropicrin
Nitrogen monoxide	Nitric oxide
Nitrogen oxide	Nitric oxide
Nitrogen (II) oxide	Nitric oxide
Nitrotrichloromethane	Chloropicrin
Nitryl hydroxide	Nitric acid, red fuming
Nonene	Tripropylene
NCS 8819	Acrolein
NSFO	Fuel oil
NTM	Naphthalene
n-Octan-1-ol	Octyl aldehydes
1-Octanol	Octyl aldehydes
n-Octanol	Octyl aldehydes
normal-Octanol	Octyl aldehydes
n-Octan-1-ol	Octanol
1-Octanol	Octanol
n-Octanol	Octanol
Oct-1-ene	1-Octene
Octene-1	1-Octene
Octilin	Octanol
Octyl acrylate	2-Ethylhexyl acrylate
Octyl alcohol	Octanol
1- Octyl alcohol	Octanol
n-Octyl alcohol	Octanol
n-Octyl aldehyde	Octyl aldehydes
normal-Octyl aldehyde	Octyl aldehydes
1- Octylene	1-Octene
1- Octylene	1-Octene
ODB	o-Dichlorobenzene
ODCB	o-Dichlorobenzene
Oil of Mirbane	Nitrobenzene
Oil of Bitter Almonds	Nitrobenzene
Oil of Five-Siberian	Pine oil
Oil of Myrbane	Nitrobenzene
Oil of pine	Pine oil
Oil of vitriol	Sulfuric acid
Olamine	Ethanolamine

CHEMICAL	GUIDE
Olefiant gas	Ethylene
ONCB	ortho-Nitrochlorobenzene
Ortho C-11	Sodium chlorate
ortho-Xylene	Xylene
Oxacyclopentadiene	Furan
Oxacyclopentane	Tetrahydrofuran
Oxalic acid dinitrile	Cyanogen
Oxalonitrile	Cyanogen
Oxalyl cyanide	Cyanogen
Oxane	Ethylene oxide
Oxideoethane	Ethylene oxide
Oxirane	Ethylene oxide
Oxitol	Ethylene glycol monoethyl ether
Oxolane	Tetrahydrofuran
Oxole	Furan
Oxomethane	Formaldehyde solution
Oxyacyclopropane	Ethylene oxide
Oxybenzene	Carbolic acid or phenol
1,1'-Oxybisethane	Diethyl ether
Oxybismethane	Dimethyl ether
2,2'-Oxybispropane	Diisopropyl ether
Oxyfume 12	Ethylene oxide
Oxylite	Benzoyl peroxide
Oxymethylene	Formaldehyde solution
Oxytol acetate	Ethylene glycol monoethyl ether acetate
Oxytoluene	Cresol
Padiscol	Ethyl alcohol
PAN	Phthalic anhydride
Panoxyl	Benzoyl peroxide
Paracetat	Isopropyl acetate
Paraform	Formaldehyde solution
PCL	Hexachlorocyclopentadiene
PCNB	para-Nitrochlorobenzene
PDC	Propylene dichloride
Pelagol grey j	2,4-Toluylenediamine
Pelagol j	2,4-Toluylenediamine
Pentanol, 4-methyl-	Methyl Isobutyl carbinol
Pentamethylene	Cyclopentane
n-Pentane	Pentane
normal Pentane	Pentane
Perchlorocyclopentadiene	Hexachlorocyclopentadiene
Perchloroethylene	Tetrachloroethylene
Perchloromethane	Carbon tetrachloride
Perfluoroacetone	Hexafluoroacetone
Perfluoro-2-propanone	Hexafluoroacetone
Perhydrol	Hydrogen peroxide
Peroxan	Hydrogen peroxide
Peroxide	Hydrogen peroxide

CHEMICAL	GUIDE
Persadox	Benzoyl peroxide
Petroleum	Petroleum crude oil
Petroleum naphtha	Petroleum distillate, n.o.s.
Petroleum ether	Petroleum distillate, n.o.s.
Petroleum pitch	Asphalt
Petroleum spirit	Petroleum distillate, n.o.s.
Phene	Benzene
Phenethylene	Styrene monomer, inhibited
Phenic acid	Carbolic acid or phenol
Phenol	Carbolic acid or phenol
Phenol, liquid	Carbolic acid or phenol
Phenol, solution	Carbolic acid or phenol
Phenol, molten	Carbolic acid or phenol
Phenol alcohol	Carbolic acid or phenol
Phenylamine	Aniline oil
Phenyl chloride	Chlorobenzene
Phenylethane	Ethyl benzene
Phenylethene	Styrene monomer, stabilized
Phenylethylene	Styrene monomer, stabilized
Phenyl hydrate	Carbolic acid or phenol
Phenyl hydride	Benzene
Phenyl hydroxide	Carbolic acid or phenol
Phenylmethane	Toluene
Phenylic acid	Carbolic acid or phenol
Phenylic alcohol	Carbolic acid or phenol
2-Phenylpropene	Isopropylbenzene
beta-Phenylpropene	Isopropylbenzene
2-Phenylpropylene	Isopropylbenzene
beta-Phenylpropylene	Isopropylbenzene
p-Phthalic acid	Terephthalic acid
Phosphorated hydrogen	Phosphine
o-Phosphoric acid	Phosphoric acid
ortho-Phosphoric acid	Phosphoric acid
Phosphoric sulfide	Phosphorus pentasulfide
Phosphorus (III) chloride	Phosphorus trichloride
Phosphorus chloride	Phosphorus trichloride
Phosphorus chloride oxide	Phosphorus oxychloride
Phosphorous (III) hydride	Phosphine
Phosphorous trihydride	Phosphine
Phosphorus oxide trichloride	Phosphorus oxychloride
Phosphorus oxytrichloride	Phosphorus oxychloride
Phosphorus pentasulphide	Phosphorus pentasulfide
Phosphorus persulfide	Phosphorus pentasulfide
Phosphorus sulphide	Phosphorus pentasulfide
Phosphorus trichloride oxide	Phosphorus oxychloride
Phosphoryl chloride	Phosphorus oxychloride
Phthalandione	Phthalic anhydride
Phthalic acid anhydride	Phthalic anhydride
Picfume	Chloropicrin
Picride	Chloropicrin
Pic-Chlor, PS	Chloropicrin
Pimelic ketone	Cyclohexanone
Pimelin ketone	Cyclohexanone
Plastiazan 60	Ethylene glycol monoethyl ether
PNCB	para-Nitrochlorobenzene
Polychloropinene	1,1,1-Trichloroethane
Polypropylene glycol methyl ether	1-Methoxy-2-propanol
Poly-solve mpm	1-Methoxy-2-propanol
Poly-solv EE	Ethylene glycol monoethyl ether
Poly-solv EE acetate	Ethylene glycol monoethyl ether acetate
Pontamine developer tn	2,4-Toluylenediamine
Potable spirits	Ethyl alcohol
Potash liquor	Potassium hydroxide
Potash nitrates	Potassium nitrate
Potassa	Potassium hydroxide
Potassium hydrate	Potassium hydroxide
Profume	Chloropicrin
Prop-2-en-1-al	Acrolein
Propanal	Propionaldehyde
Propanal,3-(methylthio)-(9Cl)	4-Thiapentanal
Propane	Petroleum gas, liquefied
1-Propanamine	Propylamine
2-Propanamine	Diisopropylamine
2-Propaneamine	Isopropylamine
Propane motor fuel	Petroleum gas, liquefied
2-Propanol	Isopropanol
Propanone	Acetone
2-Propanone	Acetone
Propanol solvent m	1-Methoxy-2-propanol
Propellant-12	Dichlorodifluoromethane
2-Propenal	Acrolein
2-Propenamide	Allylamine
2-Propenamine	Allylamine
2-Propen-1-amine	Allylamine
1-Propene	Dichloropropene
Propene acid	Acrylic acid, stabilized
Propene nitrile	Acrylonitrile
Propene oxide	Propylene oxide
2-Propenenitrile	Acrylonitrile
Propene tetramer	Propylene tetramer
2-Propen-1-ol	Allyl alcohol
Propen-1-ol-3	Allyl alcohol
2- Propen-1-one	Acrolein
Propenoic acid	Acrylic acid, stabilized
2-Propenoic acid	Acrylic acid, stabilized
Propenoic acid amide	Acrylamide
2-Propenoic acid, butyl ester	Butyl acrylate
2-Propenoic acid, ethyl ester	Ethyl acrylate
2-Propenoic acid, 2-ethylhexyl ester	2-Ethylhexyl acrylate
2-Propenoic acid, methyl ester	Methyl acrylate, inhibited
2-Propenoic acid, 2-methyl-, ethyl ester	Ethyl methacrylate
2-Propenoic acid, 2-methyl-, methyl ester	Methyl methacrylate
Propenol	Allyl alcohol
1-Propenol-3	Allyl alcohol
Propenyl alcohol	Allyl alcohol
2-Propenyl alcohol	Allyl alcohol
2-Propenyl amine	Allylamine
Propional	Propionaldehyde
Propionic aldehyde	Propionaldehyde
n-Propyl acetate	Propyl acetate
1-Propyl acetate	Propyl acetate
2-Propyl acetate	Isopropylacetate

CHEMICAL	GUIDE
sec-Propyl alcohol	Isopropanol
Propyl aldehyde	Propionaldehyde
n-Propyl-carbinol	Butyl alcohol
n-Propylcarbinyl	Chlorobutanes
n-Propyl-1-propanamine	Di-n-propylamine
Propylene aldehyde	Crotonaldehyde
Propylene glycol 1-methyl ether	1-Methoy-2-propanol
Propylene glycol methyl ether	1-Methoy-2-propanol
Propylene glycol monomethyl ether (PGME)	1-Methoy-2-propanol
1,2-Propyleneimine	Propyleneimine
1,2-Propylene oxide	Propylene oxide
Propylene trimer	Tripropylene
2-Propyl ethanoate	Isopropyl acetate
Propylic aldehyde	Propionaldehyde
Prozion	Propionic acid
Prussic acid	Hydrocyanic acid
Pseudoacetic acid	Propionic acid
Purssite	Cyanogen
Pyroacetic ether	Acetone
Pyrobenzol	Benzene
Pyrobenzole	Benzene
Pyrofax	Petroleum gas, liquefied
Pyroligneous spirit	Methanol
Pyrosulphuric acid	Oleum
Pyroxylic spirit	Methanol
Pyrrolylene	Butadiene
Quinol	Hydroquinone
R-12	Dichlorodifluoromethane
R-20	Chloroform
R-22	Chlorodifluoromethane
R-40	Methyl chloride
R1113	Trifluorochloroethylene, inhibited
Range oil	Kerosene
Refrigerant-12	Dichlorodifluoromethane
Refrigerant gas 143a	1.1.1-Trifluoroethane
Renal md	2.4-Toluylenediamine
Rock oil	Petroleum crude oil
Rotex	Methyl bromide
Rubbing alcohol	Isopropanol
Saltpeter	Potassium nitrate
Sand acid	Hydrofluorosilicic acid
SBA	Butyl alcohol
Sconatex	Vinylidene chloride
Selane	Hydrogen selenide
Selenium anhydride	Hydrogen selenide
Selenium dihydride	Hydrogen selenide
Selenium hydride	Hydrogen selenide
Sewer gas	Hydrogen sulfide
Sextone	Cyclohexanone
Silicic acid, tetramethyl ester	Methyl orthosilicate
Silicofluoric acid	Hydrofluorosilicic acid
Silicon chloride	Silicon tetrachloride
Skelly solve	Pentane
Soda chlorate	Sodium chlorate
Soda, lye	Sodium hydroxide
Soda niter	Sodium nitrate
Soda saltpeter	Sodium nitrate
Sodium aluminum dioxide	Sodium aluminate
Sodium aluminum oxide	Sodium aluminate

CHEMICAL	GUIDE
Sodium bisulfide	Sodium hydrosulfide
Sodium cyanide, cyanobrik	Sodium cyanide, solid
Sodium cyanide, solution	Sodium cyanide, solid
Sodium dithionite	Sodium hydrosulfite
Sodium hydrate	Sodium hydroxide
Sodium hydrogen sulfide	Sodium hydrosulfide
Sodium hydrosulphide	Sodium hydrosulfide
Sodium mercaptan	Sodium hydrosulfide
Sodium mercaptide	Sodium hydrosulfide
Sodium metaaluminate	Sodium aluminate
Sodium Methyldithiocarbamate	Metam sodium
Sodium sulfoxylate	Sodium hydrosulfite
Sodium sulhydrate	Sodium hydrosulfite
Solvent ether	Diethyl ether
Solvent naphtha	Coal tar distillates
Spirit of hartshorn	Ammonia, anhydrous
Spirit of salts	Hydrochloric acid
Styrol	Styrene monomer, stabilized
Styrole	Styrene monomer, stabilized
Styrolene	Styrene monomer, stabilized
Styron	Styrene monomer, stabilized
Styropol	Styrene monomer, stabilized
Sulfonic acid, monochloride	Chlorosulfonic acid
Sulfuretted hydrogen	Hydrogen sulfide
Sulfur hydride	Hydrogen sulfide
Sulfur oxychloride	Thionyl chloride
Sulfur monochloride	Sulfur chloride
Sulfur oxide	Sulfur dioxide
Sulfur subchloride	Sulfur chloride
Sulfuric acid, dimethyl ester	Dimethyl sulfate
Sulfuric anhydride	Sulfur trioxide, inhibited
Sulfuric chlorohydrin	Chlorosulfonic acid
Sulfuric dimethyl ester acid	Dimethyl sulfate
Sulfuric ether	Diethyl ether
Sulfurous acid anhydride	Sulfur dioxide
Sulfurous anhydride	Sulfur dioxide
Sulfurous oxide	Sulfur dioxide
Sulfurous oxychloride	Thionyl chloride
Sulfurous chloride	Thionyl chloride
Sulphocarbonic anhydride	Carbon disulfide
Sulphur chloride	Sulfur chloride
Sulphur dioxide	Sulfur dioxide
Sulphur monochloride	Sulfur chloride
Sulphuric acid	Sulfuric acid
Sulphuric acid, fuming	Oleum
Sulphuric acid, spent	Sulfuric acid, spent
Superoxol	Hydrogen peroxide
sym-Dibromoethane	Ethylene dibromide
Tannic chloride	Titanium tetrachloride
Tar	Asphalt
Tar camphor	Naphthalene
Tar oil	Coal tar distillates
TCB	Trichlorobenzenes, liquid
TCE	Trichloroethylene

CHEMICAL	GUIDE
1,1,1-TCE	Trichloroethylene
TDI	Toluene diisocyanate
Tecquinol	Hydroquinone
Tetrachlorocarbon	Carbon tetrachloride
Tetrachloromethane	Carbon tetrachloride
Tetrachlorosilane	Silicon tetrachloride
Tetraethyl lead	Motor fuel antiknock compound
Tetrafinol	Carbon tetrachloride
Tetraform	Carbon tetrachloride
Tetrafluoroethane	1,1,1,2-Tetrafluoroethane
Tetral g	2,4-Toluylenediamine
Tetramethoxysilane	Methyl orthosilicate
Tetramethyl lead	Motor fuel antiknock compound
Tetramethyl orthosilicate	Methyl orthosilicate
Tetramethyl silicate	Methyl orthosilicate
Tetramethylene cyanide	Adiponitrile
Tetramethylene dicyanide	Adiponitrile
Tetramethylene oxide	Tetrahydrofuran
Tetramethyloxsilane	Methyl orthosilicate
Tetrapropylene	Propylene tetramer
Tetrasol	Carbon tetrachloride
Tetrole	Furan
THF	Tetrahydrofuran
Thia-4-pentanal	4-Thiapentanal
Thioethanol	Ethyl mercaptan
Thioethyl alcohol	Ethyl mercaptan
Thiomethyl alcohol	Methyl mercaptan
Thiophosphoric anhydride	Phosphorus pentasulfide
Titanic chloride	Titanium tetrachloride
Titanic (IV) chloride	Titanium tetrachloride
Titanium chloride	Titanium tetrachloride
TMA	Trimethylamine
Toluene-2,4-diamine	2,4-Toluylenediamine
Toluenediamine	2,4-Toluylenediamine
2,4-Toluene diisocyanate	Toluene diisocyanate
Toluene-2,4-diisocyanate	Toluene diisocyanate
Toluene isocyanate	Toluene diisocyanate
Toluol	Toluene
Tolu-sol	Toluene
Tolyiene-2,4-diisocyanate	Toluene diisocyanate
Tolyene diisocyanate	Toluene diisocyanate
Tolyene isocyanate	Toluene diisocyanate
Toxilic anhydride	Maleic anhydride
TPA	Terephthalic acid
trans-Acrolein	Acrolein
1,2,3-Trichlorobenzene	Trichlorobenzenes, liquid
1,2,4-Trichlorobenzene	Trichlorobenzenes, liquid
unsym-Trichlorobenzene	Trichlorobenzenes, liquid
1,2,4-Trichlorobenzol	Trichlorobenzenes, liquid
Trichloroborane	Boron trichloride
Trichloroethene	Trichloroethylene
1,1,2-Trichloroethylene	Trichloroethylene
1,2,2-Trichloroethylene	Trichloroethylene
Trichloroform	Chloroform
Trichloromethane	Chloroform
Trichloromethylmethane	1,1,1-Trichloroethane
Trichloromethylsilane	Methyldichlorosilane
Trichloromethylsilicon	Methyldichlorosilane
Trichloronitromethane	Chloropicrin

CHEMICAL	GUIDE
Trichlorophosphorus oxide	Phosphorus oxychloride
Trichlorophosphine oxide	Phosphorus oxychloride
Tri-chlor	Chloropicrin
Tricresol	Cresol
Trifluorovinyl chloride	Trifluorochloroethylene, inhibited
Trimethylcarbinol	Butyl alcohol
Trimethylmethane	Isobutane
2,4,4-Trimethylpentane	Diisobutylene
2,4,4-Trimethylpentane-2	Diisobutylene
2,4,4-Trimethyl-1-pentene	Diisobutylene
Triosulfurous dichloride	Sulfur chloride
Trioxychlorofluoride	Perchloryl fluoride
T-stuff	Hydrogen peroxide
UF_6	Uranium hexafluoride
Uranium fluoride	Uranium hexafluoride
Uranium (VI) fluoride	Uranium hexafluoride
Valine aldehyde	Isobutyraldehyde
VAM	Vinyl acetate
Vatrolite dithionous, disodium salt	Sodium hydrosulfite
VC	Vinyl chloride
VCL	Vinyl chloride
VCM	Vinyl chloride
Ventox	Acrylonitrile, stabilized
Vinegar acid	Acetic acid
Vinyl acetate monomer	Vinyl acetate
Vinyl amide	Acrylamide
Vinylamine	Ethyleneimine
Vinylbenzene	Styrene monomer, stabilized
Vinylbenzol	Styrene monomer, stabilized
Vinyl carbinol	Allyl alcohol
Vinyl C monomer	Vinyl chloride
Vinyl cyanide	Acrylonitrile, stabilized
Vinyl formic acid	Acrylonitrile, stabilized
Violet 3	Xylene
Vyac	Vinyl acetate
White phosphoric acid	Phosphoric acid
White tar	Naphthalene
Wood alcohol	Methanol
Wood ether	Dimethyl ether
Wood naphtha	Methanol
Wood spirit	Methanol
m-Xylene	Xylene
meta-Xylene	Xylene
o-Xylene	Xylene
ortho-Xylene	Xylene
p-Xylene	Xylene
para-Xylene	Xylene
Xylol	Xylene
Zeset T	Vinyl acetate
Zoba gke	2,4-Toluylenediamine
Zoba developer h	2,4-Toluylenediamine

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APPENDIX G
UN CROSS REFERENCE
(All numbers have the prefix UN unless otherwise indicated)

ID NO	GUIDE
1005	Anhydrous ammonia
1006	Argon
1010	Butadiene
1011	Butane
1012	Butylene
1013	Carbon dioxide
1016	Carbon monoxide
1017	Chlorine
1018	Chlorodifluoromethane
1026	Cyanogen, liquefied
1028	Dichlorodifluoromethane
1032	Dimethylamine, anhydrous
1033	Ethylene amine
1037	Ethyl chloride
1038	Ethylene
1040	Ethylene oxide
1046	Helium, compressed
1048	Hydrogen bromide, anhydrous
1049	Hydrogen, compressed
1050	Hydrogen chloride, anhydrous
1051	Hydrocyanic acid
1052	Hydrogen fluoride, anhydrous
1053	Hydrogen sulfide, liquefied
1055	Isobutylene
1061	Methylamine, anhydrous
1062	Methyl bromide
1063	Methyl chloride
1064	Methyl mercaptan
1066	Nitrogen, compressed
1067	Nitrogen tetroxide/Dinitrogen tetroxide, liquefied
1070	Nitrous oxide, compressed
1072	Oxygen, compressed
1073	Oxygen, refrigerated liquid
1075	Liquefied petroleum gas
1076	Phosgene
1077	Propylene
1079	Sulfur dioxide, liquefied
1083	Trimethylamine, anhydrous
1085	Vinyl bromide, inhibited
1086	Vinyl chloride
1089	Acetaldehyde
1090	Acetone
1092	Acrolein, inhibited
1093	Acrylonitrile, inhibited
1098	Allyl alcohol
1100	Allyl chloride
1114	Benzene
1120	Butyl alcohol
1123	Butyl acetate
1125	Butylamine
1127	Chlorobutanes
1129	Butyraldehyde
1131	Carbon disulfide/Carbon bisulfide
1134	Chlorobenzene
1136	Coal tar distillates
1143	Crotonaldehyde
1145	Cyclohexane
1146	Cyclopentane
1154	Diethylamine
1155	Dithyl ether
1159	Diisopropylether
1162	Dimethyldichlorosilane
1170	Ethyl alcohol
1171	Ethylene glycol monoethyl ether
1172	Ethylene glycol monoethyl ether acetate
1173	Ethyl acetate
1175	Ethyl benzene
1182	Ethyl chloroformate
1184	Ethylene dichloride
1185	Ethyleneimine, inhibited
1193	Methyl ethyl ketone
1198	Formaldehyde solution
1203	Gasoline
1206	Heptane
1208	Hexane
1213	Isobutyl acetate
1218	Isoprene, inhibited
1219	Isopropanol
1220	Isopropyl acetate
1221	Isopropylamine
1223	Kerosene
1230	Methanol
1235	Methylamine, aqueous solution
1238	Methyl chloroformate
1239	Methylchloromethyl ether
1242	Methyldichlorosilane
1243	Methyl formate
1244	Methyl hydrazine
1245	Methyl isobutyl ketone
1247	Methyl methacrylate monomer, inhibited
1250	Methyltrichlorosilane
1259	Nickel carbonyl

ID NO	GUIDE
1265	Pentane
1267	Petroleum crude oil
1268	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
1270	Petroleum oil
1272	Pine oil
1274	n-Propanol
1275	Propionaldehyde
1276	Propyl acetate
1279	Propylene dichloride or 1,2-dichloropropane
1280	Propylene oxide
1282	Pyridine
1294	Toluene
1297	Trimethylamine
1301	Vinyl acetate, inhibited
1303	Vinylidene chloride, inhibited
1307	Xylene
1334	Naphthalene
1340	Phosphorus pentasulfide
1350	Sulfur
1381	Phosphorus, white or yellow
1384	Sodium hydrosulfite
1402	Calcium carbide
1428	Sodium (metal)
NA1463	Chromic acid, solid
1463	Chromium trioxide, anhydrous
1486	Potassium nitrate
1498	Sodium nitrate
1541	Acetone cyanohydrin, stabilized
1547	Aniline oil
1553	Arsenic acid, liquid
1560	Arsenic trichloride
1561	Arsenic trioxide
1569	Bromoacetone
1578	Chloronitro benzene or meta-Nitrochlorobenzene
1578	Chloronitro benzene or ortho-Nitrochlorobenzene
1578	Chloronitro benzene or para-Nitrochlorobenzene
1580	Chloropicrin
1583	Chloropicrin mixtures
1589	Cyanogen chloride, inhibited
1591	o-Dichlorobenzene
1593	Dichloromethane
1595	Dimethyl sulfate
1600	Dinitrotoluenes, molten
1605	Ethylene dibromide
1613	Hydrocyanic acid, aqueous solutions
1614	Hydrogen cyanide, stabilized
1649	Motor fuel antiknock compound/Tetraethyl lead
1660	Nitric oxide
1661	ortho-Nitroaniline
1662	Nitrobenzene
1671	Phenol, solid or carbolic acid
1689	Sodium cyanide
1710	Trichloroethylene
1715	Acetic anhydride
1741	Boron trichloride
1744	Bromine
1748	Calcium hypochlorite
1750	Chloroacetic acid, solution
1751	Chloroacetic acid, solid
1754	Chlorosulfonic acid
1755	Chromic acid solution
NA1760	Ferrous chloride, solution
1778	Hydrofluorosilicic acid/Fluorosilicic acid
1779	Formic acid
1783	Hexamethylene diamine solution
1789	Hydrochloric acid
1790	Hydrofluoric acid, solution
1796	Nitrating acid mixtures
1805	Phosphoric acid
1809	Phosphorus trichloride
1810	Phosphorus oxychloride
1813	Potassium hydroxide, solid
1814	Potassium hydroxide, solution
1818	Silicon chloride/Silicon tetrachloride
1819	Sodium aluminate, solution
1823	Sodium hydroxide, solid
1824	Sodium hydroxide solution
1826	Nitrating acid mixtures, spent
1828	Sulfur chloride
1830	Sulfuric acid
1831	Fuming sulfuric acid or oleum
1832	Sulfuric acid, spent
1838	Titanium tetrachloride
1845	Carbon dioxide, solid
1846	Carbon tetrachloride
1848	Propionic acid
1866	Resin solution
1888	Chloroform
1897	Tetrachloroethylene
NA1911	Diborane mixtures
1911	Diborane
1915	Cyclohexanone
1917	Ethyl acrylate, inhibited
1918	Isopropylbenzene
1921	Propyleneimine, inhibited
1942	Ammonium nitrate
1951	Argon, refrigerated liquid
1962	Ethylene, compressed
1963	Helium, refrigerated liquid
1966	Hydrogen, refrigerated liquid
1969	Isobutane
1972	Methane or natural gas, refrigerated gas or liquefied natural gas

ID NO	GUIDE
1977	Nitrogen, refrigerated liquid
1991	Chloroprene, inhibited
NA1993	Fuel oil
NA1986	Denatured alcohol
NA1987	Denatured alcohol
1999	Tars, liquid or asphalt
2014	Hydrogen peroxide, aqueous solutions
2015	Hydrogen peroxide, aqueous solutions, stabilized
2022	Cresilic acid or cresol
2023	Epichlorohydrin
2029	Hydrazine, anhydrous or aqueous solution
2030	Hydrazine, hydrate or aqueous solution
2031	Nitric acid
2032	Nitric acid, red fuming
2038	Dinitrotoluenes (solid or liquid)
2045	Isobutyraldehyde
2050	Diisobutylene
2055	Styrene monomer, inhibited
2056	Tetrahydrofuran
2057	Tripropylene
2067	Ammonium nitrate fertilizer
2069	Ammonium nitrate mixed fertilizer
2072	Ammonium nitrate fertilizers
2073	Ammonium solutions
2076	Cresol
2078	Toluene diisocyanate
2186	Hydrogen chloride, refrigerated liquid
2187	Carbon dioxide, refrigerated liquid
2189	Dichlorosilane
2199	Phosphine
2201	Nitrous oxide, refrigerated
2202	Hydrogen selenide, anhydrous
2205	Adiponitrile
2208	Calcium hypochlorite mixtures, dry
2209	Formaldehyde solution
2214	Phthalic anhydride
2215	Maleic anhydride or maleic acid
2218	Acrylic acid, inhibited
2248	Di-n-butylamine
2265	N,N-Dimethylformamide
2277	Ethyl methacrylate
2303	Isopropenylbenzene
2304	Naphthalene, molten
2312	Phenol, molten or carbolic acid
2318	Sodium hydrosulfide
2321	Trichlorobenzenes, liquid
2334	Allylamine
2337	Phenyl mercaptan
2348	Butyl acrylate
2363	Ethyl mercaptan
2370	1-Hexene
2383	Di-n-propylamine
2389	Furan
2398	Methyl tert-butyl ether
2407	Isopropyl chloroformate
2420	Hexafluoroacetone
2421	Nitrogen trioxide
2426	Ammonium nitrate, liquid
2428	Sodium chlorate, aqueous solution
2447	Phosphorus, white or yellow
NA2448	Sulfur, molten
2454	Methy fluoride
2480	Methyl isocyanate
2489	Methylene diphenyl diisocyanate
2491	Ethanolamine
2531	Methacrylic acid, inhibited
2581	Aluminum chloride, solution
2582	Ferric chloride solution
NA2584	Dodecylbenzenesulfonic acid
2606	Methyl orthosilicate
2646	Hexachlorocyclopentadiene
2662	Hydroquinone
2672	Ammonium hydroxide/Ammonia solutions
2683	Ammonium sulfide solution
2716	1,4-Butynediol
2785	4-Thiapentanal
2789	Acetic acid, glacial/Acetic acid, solution
2790	Acetic acid, solution
2812	Sodium aluminate, solid
2821	Phenol solutions
2831	1,1,1-Trichlorethane
2850	Propylene tetramer
2874	Furfuryl alcohol
2880	Calcium hypochlorite
2949	Sodium hydrosulfide solution
2978	Uranium hexafluoride
2984	Hydrogen peroxide, aqueous solutions
3083	Perchloryl fluoride
3159	1,1,1,2-Tetrafluoroethane
3250	Chloroacetic acid, molten
3293	Hydrazine, aqueous solution
3453	Phosphoric acid, solid

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APPENDIX H
STCC CROSS REFERENCE LIST AND INDEX

HAZMAT CODE	GUIDE
4901506	Ammonium nitrate fertilizer
4901546	Ammonium nitrate
4904210	Anhydrous ammonia
4904304	1,1,1,2-Tetrafluoroethane
4904340	Nitrous oxide, compressed
4904345	Nitrous oxide, refrigerated liquid
4904502	Argon, compressed
4904503	Argon, refrigerated liquid
4904509	Carbon dioxide, refrigerated liquid
4904516	Dichlorodifluoromethane
4904520	Chlorodifluoromethane
4904535	Carbon dioxide, compressed
4904539	Helium, refrigerated liquid
4904540	Helium, compressed
4904561	Dichlorodifluoromethane
4904565	Nitrogen, compressed
4904566	Nitrogen, refrigerated liquid
4904569	Nitrogen, compressed
4905405	Vinyl bromide, inhibited
4905411	Ethylamine
4905414	Methylamine, anhydrous
4905425	Diborane, mixtures
4905426	Butylene
4905440	Methyl fluoride
4905510	Dimethylamine, anhydrous
4905540	Trimethylamine
4905703	Butadiene, inhibited
4905704	Butadiene, inhibited
4905705	Butadiene, inhibited
4905712	Ethyl chloride
4905715	Butylene
4905734	Ethylene
4905735	Ethylene, refrigerated liquid
4905745	Hydrogen, refrigerated liquid
4905746	Hydrogen, compressed
4905752	Liquefied petroleum gas
4905756	Natural gas or methane, refrigerated liquid
4905757	Isobutylene
4905761	Methyl chloride
4905787	1,1,1-Trifluoroethane
4905792	Vinyl chloride
4906225	Hydrazine, anhydrous
4906420	Acrylonitrile, inhibited
4906620	Propylene oxide
4907040	Propyleneimine, inhibited
4907210	Acetaldehyde
4907215	Ethyl acrylate, inhibited
4905716	1,1-Difluoroethane
4907223	Chloroprene, inhibited
4907230	Isoprene, inhibited
4907232	Ethyl methacrylate
4907235	Styrene monomer, inhibited
4907250	Methyl methacrylate monomer, inhibited
4907255	Methyl methacrylate monomer, inhibited
4907265	Styrene monomer, inhibited
4907270	Vinyl acetate
4907273	Formaldehyde solution
4907274	Formaldehyde solution
4907280	Vinylidene chloride
4907412	Allyl chloride
4907452	Methyl orthosilicate
4907610	Dimethyldichlorosilane
4907630	Methyltrichlorosilane
4907815	Diethylamine
4907840	Methylamine, aqueous solution
4907875	1-Octene
4907880	Trimethylamine, aqueous solution
4908105	Acetone
4908110	Benzene
4908120	n-Butylamine
4908125	Carbon disulfide
4908132	Cyclohexane
4908135	Cyclopentane
4908156	Diethyl ether
4908157	Diethyl ether
4908169	Ethyl mercaptan
4908175	Gasoline
4908176	Gasoline
4908177	Gasoline
4908182	1-Hexene
4908183	Hexane
4908185	Isobutyraldehyde
4908194	Isopropylamine
4908195	Diisopropyl ether
4908225	Methyl formate
4908255	Pentane
4908270	Propionaldehyde
4908285	Tetrahydrofuran
4908290	Tetrahydrofuran
4909116	Butyl acetate
4909117	Butanols or butyl alcohol
4909128	Butyl acetate
4909130	Butanols or butyl alcohol
4909135	N,N-Dimethylformamide
4909137	Crotonaldehyde, stabilized
4909141	Denatured alcohol
4909151	Denatured alcohol
4909152	Denatured alcohol
4909157	Dipropylamine
4909160	Ethyl acetate
4909163	Ethylbenzene
4909175	Furan
4909178	Toluene
4909190	Heptane
4909198	Xylene

HAZMAT CODE	GUIDE
4909205	Isopropanol
4909207	Isobutyl acetate
4909209	Diisobutylene, isomeric compounds
4909210	Isopropyl acetate
4909227	Isopropanol
4909228	Isopropanol
4909229	Isopropanol
4909230	Methanol
4909237	Methanol
4909243	Ethyl methyl ketone or methyl ethyl ketone
4909244	Methyl isobutyl ketone
4909249	Tripropylene
4909268	n-Propyl acetate
4909277	Pyridine
4909305	Toluene
4909309	1Methoxy-2-propanol
4909313	1Methoxy-2-propanol
4909348	Xylene
4909349	Xylene
4909351	Xylene
4909356	Toluene
4909363	Denatured alcohol
4909377	Methanol
4909378	Methanol
4909379	Methanol
4909380	Methanol
4909381	Methanol
4909382	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4909383	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4909391	Xylene
4909392	Xylene
4909393	Xylene
4909394	Xylene
4909395	Xylene
4909396	Xylene
4909397	Xylene
4910132	Coal tar distillates, flammable
4910135	Coal tar distillates, flammable
4910137	Coal tar distillates, flammable
4910139	Coal tar distillates, flammable
4910165	Petroleum crude oil
4910215	Xylene
4910220	Asphalt
4910242	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4910256	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4910260	Asphalt
4910261	Asphalt
4910280	Resin solution
4910282	Resin solution
4910290	Denatured alcohol
4910324	1-Octene
4910325	1-Octene
4910347	Isopropyl acetate
4910445	1-Hexene
4912003	Asphalt
4912016	Ethylene glycol monoethyl ether
4912017	Ethylene glycol monoethyl ether acetate
4912043	Methyl isobutyl carbinol
4912044	Formaldehyde solution
4912045	Formaldehyde solution
4912064	Octyl alcohols
4912079	Cyclohexanone
4912093	Octyl alcohols
4912211	Fuel oil
4912213	Fuel oil
4912215	Butyl acrylate, inhibited
4912216	Fuel oil
4912219	Fuel oil
4912233	Coal tar distillates, flammable
4912236	Coal tar distillates, flammable
4912244	Pine oil
4912271	Kerosene
4912294	Kerosene
4912298	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4912299	Kerosene
4912335	Fuel oil
4912236	Fuel oil
4912361	Asphalt
4912618	Fuel oil
4912620	Fuel oil
4912631	Isopropenylbenzene
4912675	Propylene tetramer
4913128	Isooctyl alcohol
4913129	Isooctyl alcohol
4913229	Isooctyl alcohol
4913261	Methyl isobutyl carbinol
4913262	Propylene tetramer
4914009	Ethylene glycol monobutyl ether
4914051	Isopropenylbenzene
4914108	2-Ethylhexyl acrylate
4914014	Octyl alcohols
4914117	Butanols or butyl alcohol
4914120	Formaldehyde solution
4914126	Petroleum Naphtha
4914127	Coal tar distillates
4914130	Butanols or butyl alcohol
4914133	Coal tar distillates, flammable
4914136	Coal tar distillates, flammable
4914137	Coal tar distillates, flammable
4914139	Coal tar distillates, flammable
4914162	Asphalt
4909153	Chlorobenzene
4914164	Fuel oil
4914165	Kerosene
4914168	Fuel oil
4914198	Xylene
4914216	Butyl acrylate, inhibited
4914220	Asphalt
4914233	Ethylene glycol monobutyl ether
4914246	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4914247	Petroleum distillates, n.o.s. or petroleum products, n.o.s.

HAZMAT CODE	GUIDE
4914256	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4914264	Petroleum distillates, n.o.s. or petroleum products, n.o.s.
4914266	Butyl acrylate
4914348	Xylene
4914349	Xylene
4914391	Xylene
4914392	Xylene
4914395	Xylene
4914396	Xylene
4914397	Resin solution
4914850	Kerosene
4914851	Fuel oil
4914852	Kerosene
4914848	Fuel oil
4915407	Ethylene glycol monobutyl ether
4916141	Phosphorus, white or yellow
4916179	Sodium dithionite or sodium hydrosulfite
4916180	Sodium hydrosulfide
4916320	Phosphorus pentasulfide
4916365	Methyldichlorosilane
4916408	Calcium carbide
4916456	Sodium (metal)
4918310	Ammonium nitrate fertilizer
4918311	Ammonium nitrate
4918335	Hydrogen peroxide, stabilized
4918506	Ammonium nitrate
4918510	Chromium trioxide, anhydrous or chromic acid, anhydrous
4918511	Chromic acid, solid
4918689	Hydrogen peroxide aqueous solution
4918697	Ammonium nitrate fertilizer, n.o.s.
4918698	Ammonium nitrate fertilizer, n.o.s.
4918705	Ammonium nitrate mixed fertilizer
4918715	Calcium hypochlorite, dry
4918723	Sodium chlorate
4918737	Potassium nitrate
4918746	Sodium nitrate
4918774	Ammonium nitrate, liquid
4918775	Hydrogen peroxide, aqueous solution
4918784	Ammonium nitrate fertilizer
4918795	Calcium hypochlorite, hydrated
4918802	Ammonium nitrate fertilizer
4918803	Ammonium nitrate fertilizer
4918806	Calcium hypochlorite mixtures, dry
4920107	Diborane
4920122	Hydrogen selenide, anhydrous
4920160	Phosphine
4920178	Cyanogen chloride, inhibited
4920184	Phosgene
4920349	Boron trichloride
4920353	Ethylene oxide
4920355	Methyl mercaptan
4920349	Boron trichloride
4920359	Ammonia, anhydrous
4920395	Cyanogen
4920399	Carbon monoxide, compressed
4920502	Ammonia, anhydrous
4920511	Carbon monoxide, refrigerated liquid
4920503	Hydrogen chloride, compressed
4920504	Hydrogen chloride, refrigerated liquid
4920508	Sulfur dioxide
4920513	Hydrogen sulfide
4920518	Methyl bromide
4920523	Chlorine
4921004	Allylamine
4921005	Epichlorohydrin
4921019	Allyl alcohol
4921020	Ethyl chloroformate
4921028	Hydrocyanic acid, aqueous solution
4921030	Motor fuel antiknock compound
4921032	Motor fuel antiknock compound
4921045	Motor fuel antiknock compound
4921062	Chloroacetic acid, molten
4921210	Phenol solutions or carbolic acid
4921248	Crotonaldehyde, stabilized
4921221	Carbolic acid or phenol
4921224	Dinitrotoluenes
4921252	Isopropyl chloroformate
4921401	Acetone cyanohydrin, stabilized
4921405	Dimethyl sulfate
4921410	Aniline or anilin oil
4921414	Chloropicrin
4921416	Chloropicrin mixtures, n.o.s.
4921417	Hydrocyanic acid, aqueous solution
4921445	Motor fuel antiknock mixtures or compounds
4921455	Nitrobenzene
4921459	Chloronitrobenzene or nitrochlorobenzene
4921466	Nitroanilines
4921467	Nitroanilines
4921492	Aniline or anilin oil
4921497	Ethylene dibromide
4921575	Toluene diisocyanate
4921598	Carbolic acid or phenol
4921603	Chloronitrobenzene or nitrochlorobenzene
4921638	Chloronitrobenzene or nitrochlorobenzene
4921640	Nitroanilines
4921706	Cresol
4921718	Dinitrotoluenes
4921722	Hexachlorocyclopentadiene
4921727	Bromoacetone
4921738	Dinitrotoluenes
4921767	Chloroform
4921769	Chloroform
4921830	Carbon tetrachloride
4921831	Carbon tetrachloride
4923106	Arsenic acid, liquid
4923114	Chloroacetic acid, solution
4923115	Arsenic trioxide
4923116	Chloroacetic acid, solid
4923209	Arsenic trichloride
4923227	Sodium cyanide, solid
4923228	Sodium cyanide, solid
4925021	Phenol solutions or carbolic acid

HAZMAT CODE	GUIDE
4925121	Trichlorobenzenes, liquid
4925125	1,4-Butynodiol
4925128	Ethylene glycol monobutyl ether
4925129	Hydroquinone
4921575	2,4-Toluylenediamine
4925181	Trichloroethylene
4925182	1,1,1-Trichloroethane
4925203	o-Dichlorobenzene
4925206	4-Thiapentanal
4925208	Furfuryl alcohol
4925212	Adiponitrile
4925229	Ethylene glycol monobutyl ether
4925252	Hydrazine, aqueous solution
4927006	Ethyleneimine, inhibited
4927007	Acrolein, inhibited
4927008	Methyl chloroformate
4927009	Methyl isocyanate
4927010	Nickel carbonyl
4927011	Methylhydrazine
4927012	Methylchloromethyl ether
4927014	Hydrocyanic acid, stabilized
4929114	Uranium hexafluoride
4929115	Uranium hexafluoride
4929121	Thorium ore
4930018	Hydrazine, anhydrous
4930022	Hydrofluoric acid
4930024	Hydrogen fluoride, anhydrous
4930026	Hydrofluorosilicic acid
4930030	Sulfuric acid, fuming or oleum
4930040	Sulfuric acid
4930042	Sulfuric acid, spent
4930066	Sulfuric acid, fuming or oleum
4930204	Chlorosulfonic acid
4930206	Chromic acid, solution
4930216	Sulfuric acid
4930217	Sulfuric acid
4930218	Nitrating acid mixtures
4930223	Nitric acid
4930228	Hydrochloric acid
4930231	Hydrochloric acid
4930245	Nitrating acid
4930247	Phosphoric acid
4930248	Phosphoric acid
4930249	Phosphoric acid
4930251	Methacrylic acid, inhibited
4930254	Nitrating acid mixtures, spent
4930255	Nitrating acid mixtures, spent
4931201	Nitric acid, fuming
4931303	Acetic acid, glacial
4931304	Acetic anhydride
4931320	Formic acid
4931401	Acetic acid, solution
4931405	Acrylic acid, inhibited
4931416	Chloroacetic acid
4931419	Dodecylbenzenesulfonic acid
4931426	Dodecylbenzenesulfonic acid
4931447	Propionic acid
4931484	2-Dimethylaminoethanol
4931492	2-Dimethylaminoethanol
4932320	Sulfuric acid
4932329	Ferrous chloride, solution
4932342	Ferric chloride solution
4932343	Ferric chloride solution
4932352	Phosphorus oxychloride
4932359	Phosphorus trichloride
4932370	Silicon tetrachloride
4932379	Sulfur chloride
4932385	Titanium tetrachloride
4934223	Phthalic anhydride
4935030	Hydrazine hydrate
4935206	Sodium hydroxide, solution
4935225	Potassium hydroxide, solid
4935230	Potassium hydroxide, solution
4935234	Ammonia solutions or ammonium hydroxide
4935235	Sodium hydroxide, solid
4935240	Sodium hydroxide, solution
4935244	Potassium hydroxide, solution
4935245	Sodium hydroxide, solution
4935251	Sodium hydroxide, solution
4935260	Sodium aluminate, solution
4935262	Sodium hydroxide, solid
4935267	Sodium hydrosulphide, solid
4935273	Sodium hydroxide, solution
4935280	Ammonia solutions or ammonium hydroxide
4935645	Hexamethylene diamine solution
4935647	Sodium hydroxide, solution
4935652	Sodium hydroxide, solution
4935655	Sodium hydroxide, solution
4935665	Ethanolamine
4935669	Sodium hydrosulfide, solid
4936110	Bromine
4936330	Maleic anhydride
4936343	Ammonium sulfide solution
4936351	Aluminum sulfate, solution
4936395	Sulfur chloride
4936568	Sulfuric acid
4961384	Alcohol ethoxylates
4961387	Alcohol ethoxylates
4961388	Alcohol ethoxylates
4961389	Alcohol ethoxylates
4961618	Alcohol ethoxylates
4962104	Alcohol ethoxylates
4962106	Alcohol ethoxylates
4962107	Alcohol ethoxylates
4962111	Alcohol ethoxylates
4962121	Alcohol ethoxylates
4962123	Alcohol ethoxylates
4962132	Alcohol ethoxylates

APPENDIX I
LIST OF REPORTABLE QUANTITIES FOR EAG CHEMICALS

GUIDE	REPORTABLE QUANTITY
Acetaldehyde	1000/454
Acetic acid	5000/2270
Acetic anhydride	5000/2270
Acetone	5000/2270
Acetone cyanohydrin	10/4.54
Acrolein	1/0.454
Acrylamide	5000/2270
Acrylic Acid	5000/2270
Acrylonitrile	100/45.4
Adipic acid	5000/2270
Adiponitrile	—
Alcohol ethoxylates	—
Allyl alcohol	100/45.4
Allylamine	—
Allyl bromide	—
Allyl chloride	1000/454
Aluminum chloride, solution	—
Aluminum sulfate	5000/2270
Ammonia, anhydrous	100/45.4
Ammonium hydroxide	1000/454
Ammonium nitrate	—
Ammonium sulfate	—
Ammonium sulfide solution	100/45.4
Aniline oil	5000/2270
Argon	—
Arsenic acid, liquid	1/0.454
Arsenic trichloride	1/0.454
Arsenic trioxide	1/0.454
Asphalt	—
Benzene	10/4.54
Benzoyl peroxide	—
Boron trichloride	—
Bromine	—
Bromoacetone	1000/454
Butadiene	10/4.54
Butane	—
Butyl acetate	5000/2270
Butyl acrylate	—
Butyl alcohol	5000/2270
Butylamine	1000/454
Butylene	—
1,4-Butynediol	—
Butyraldehyde	—
Calcium carbide	10/4.54
Calcium hypochlorite	10/4.54
Caprolactam	—
Carbolic acid or phenol	1000/454
Carbon disulfide	100/45.4
Carbon dioxide	—
Carbon monoxide	—
Carbon tetrachloride	10/4.54
Chlorine	10/4.54
Chloroacetic acid, solid	100/45.4
Chloroacetic acid, solution	100/45.4
Chlorobenzene	100/45.4
Chlorobutanes	—
Chlorodifluoromethane	—
Chloroform	10/4.54
Chloropicrin	—
Chloroprene	100/45.4
Chlorosulfonic acid	1000/454
Chromic acid solution	10/4.54
Chromium trioxide, anhydrous	—
Coal tar distillates	—
Cresol	100/45.4
Crotonaldehyde, stabilized	100/45.4
Cyanogen	100/45.4
Cyanogen chloride	10/4.54
Cyclohexane	1000/454
Cyclohexanone	5000/2270
Cyclopentane	—
Denatured alcohol	—
Diborane	—
Di-n-butylamine	—
o-Dichlorobenzene	100/45.4
Dichlorodifluoromethane	5000/2270
Dichloromethane	1000/454
Dichloropropene	100/45.4
Dichlorosilane	—
Dicylopentadiene	—
Diethanolamine	100/45.4
Diethylamine	1000/454
Diethyl ether	100/45.4
1,1-Difluoroethane	—
Diisobutylene	—
Diisopropylamine	—
Diisopropyl ether	—
Dimethylamine, anhydrous	1000/454
2-Dimethylaminoethanol	—
Dimethyldichlorosilane	—
Dimethyl ether	—

GUIDE	REPORTABLE QUANTITY
N,N-Dimethylformamide	100/45.4
Dimethyl sulfate	100/45.4
Dinitrotoluenes	10/4.54
Di-n-propylamine	5000/2270
Dodecylbenzenesulfonic acid	1000/454
Epichlorohydrin	100/45.4
Ethanolamine	—
Ethyl acetate	5000/2270
Ethyl acrylate	1000/454
Ethyl alcohol	—
Ethylamine	—
Ethyl benzene	1000/454
Ethyl chloride	100/45.4
Ethyl chloroformate	—
Ethylene	—
Ethylenediamine	5000/2270
Ethylene dibromide	1/0.454
Ethylene dichloride	100/45.4
Ethylene glycol	5000/2270
Ethylene glycol monobutyl ether	—
Ethylene glycol monoethyl ether	1000/454
Ethylene glycol monoethyl ether acetate	—
Ethyleneimine, inhibited	1/0.454
Ethylene oxide	10/4.54
2-Ethylhexyl acrylate	—
Ethyl mercaptan	—
Ethyl methacrylate	1000/454
Ferric chloride, solution	1000/454
Ferrous chloride, solution	100/45.4
Fluorine, compressed	10/4.54
Formaldehyde solution	100/45.4
Formic acid	5000/2270
Fuel oil	—
Furan	100/45.4
Furfuryl alcohol	—
Gasoline	—
Helium	—
Heptane	—
Hexachlorocyclopentadiene	10/4.54
Hexafluoroacetone	—
Hexamethylene diamine solution	—
Hexane	5000/2270
1-Hexene	—
Hydrazine	1/0.454
Hydrochloric acid	5000/2270
Hydrocyanic acid	10/4.54
Hydrofluoric acid	100/45.4
Hydrofluorosilicic acid	—
Hydrogen	—
Hydrogen bromide	—
Hydrogen chloride	5000/2270
Hydrogen fluoride	100/45.4
Hydrogen peroxide	—
Hydrogen selenide	—
Hydrogen sulfide	100/45.4
Hydroquinone	100/45.4
Isobutane	—
Isobutyl acetate	—
Isobutylene	—
Isobutyraldehyde	—
Isooctyl alcohol	—
Isoprene	100/45.4
Isopropanol	—
Isopropenylbenzene	—
Isopropyl acetate	—
Isopropylamine	—
Isopropylbenzene	—
Isopropyl chloroformate	—
Kerosene	—
Liquefied natural gas	—
Liquefied petroleum gas	—
Maleic anhydride	5000/2270
Metam sodium	—
Methacrylic acid, inhibited	—
Methanol	5000/2270
1-Methoxy-2-propanol	—
Methyl acrylate, inhibited	—
Methylacrylic acid, inhibited	—
Methylamine, anhydrous	100/45.4
Methylamine, aqueous solution	100/45.4
Methyl bromide	1000/454
Methyl tert-butyl ether	1000/454
Methyl chloride	100/45.4
Methyl chloroformate	1000/454
Methylchloromethyl ether	1/0.454
Methyldichlorosilane	—
Methylene diphenyl diisocyanate	5000/2270
Methyl ethyl ketone	5000/2270
Methyl fluoride	—
Methyl formate	—
Methylhydrazine	10/4.54
Methyl isobutyl carbinol	—
Methyl isobutyl ketone	5000/2270
Methyl isocyanate	10/4.54
Methyl mercaptan	100/45.4
Methyl methacrylate	1000/454
Methyl orthosilicate	—
Methyltrichlorosilane	—
Motor fuel antiknock compound	—
Naphthalene	100/45.4
Nickel carbonyl	10/4.54
Nitrating acid	1000/454
Nitric acid, red fuming	1000/454
Nitric oxide	10/4.54
ortho-Nitroaniline	—
Nitrobenzene	1000/454
meta-Nitrochlorobenzene	—
ortho-Nitrochlorobenzene	—
para-Nitrochlorobenzene	—
Nitrogen	—

GUIDE	REPORTABLE QUANTITY
Nitrogen tetroxide	—
Nitrogen trioxide	—
Nitrous oxide	—
Octanol	—
1-Octene	—
Octyl aldehydes	—
Oleum	1000/454
Oxygen	—
Pentane	—
Perchloryl fluoride	—
Petroleum crude oil	—
Petroleum distillates, n.o.s.	—
Phenyl mercaptan	100/45.4
Phosgene	10/4.54
Phosphine	100/45.4
Phosphoric acid	5000/2270
Phosphorus oxychloride	1000/454
Phosphorus pentasulfide	100/45.4
Phosphorus trichloride	1000/454
Phosphorus, white or yellow	1/0.454
Phthalic anhydride	5000/2270
Pine oil	—
Potassium hydroxide	1000/454
Potassium nitrate	—
n-Propanol	—
Propionaldehyde	1000/454
Propionic acid	5000/2270
Propyl acetate	—
Propylamine	5000/2270
Propylene	—
Propylene dichloride	1000/454
Propylene tetramer	—
Propyleneimine	1/0.454
Propylene oxide	100/45.4
Pyridine	1000/454
Resin solution	—
Silicon tetrachloride	—
Sodium aluminate	—
Sodium carbonate	—
Sodium chlorate	—
Sodium cyanide, solid	10/4.54
Sodium hydrosulfide	5000/2270
Sodium hydrosulfite	—
Sodium hydroxide	1000/454
Sodium (metal)	10/4.54
Sodium nitrate	—
Styrene monomer, stabilized	1000/454
Sulfur or molten sulfur	—
Sulfur chloride	1000/454
Sulfur dioxide	—
Sulfur trioxide, inhibited	—
Sulfuric acid	1000/454
Sulfuric acid, spent	1000/454
Terephthalic acid	—
Tetrachloroethylene	100/45.4
1,1,1,2-Tetrafluoroethane	—
Tetrahydrofuran	1000/454
4-Thiapentanal	—
Thionyl chloride	—
Thorium ore	—
Titanium dioxide	—
Titanium tetrachloride	1000/454
Toluene	1000/454
Toluene diisocyanate	100/45.4
2,4-Toluylenediamine	10/4.54
Trichlorobenzenes, liquid	100/45.4
1,1,1-Trichloroethane	1000/454
Trichloroethylene	100/45.4
Trifluorochloroethylene, inhibited	—
1,1,1-Trifluoroethane	—
Trimethylamine	100/45.4
Tripropylene	—
Uranium hexafluoride	—
Urea	—
Vinyl acetate	5000/2270
Vinyl bromide	100/45.4
Vinyl chloride	1/0.454
Vinylidene chloride	100/45.4
Xylene	100/45.4


FLAMMABLE
SOLID
4